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Railways, Street Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous Contracts and Supplies.

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The cost of railway cars has been given in a paragraph which has been going the rounds of the press, and which we rearrange below, adding the official prices of cars which have been illustrated and described in our columns, these latter being marked with a star (*). The prices of the freight cars include power brakes and M. C. B. couplers.

Flat car	$380
Coal car, flat bottom, 50,000 lbs. capacity*.....	475
Coal car, drop bottom, 60,000 lbs. capacity*.....	483
Coal car, double hopper bottom.....	525
Coke car, double hopper bottom.....	540
Ore car, hopper bottom, 53,760 lbs. capacity*...	450
Box car	600
Stock car	550
Fruit car, ventilated	700
Refrigerator car	800
Caboose, four-wheel, $550; eight-wheel.....	700
Mail and baggage car, 50 ft. long.....	3,500
Passenger car, second-class	4,800
Passenger car, first-class	5,500
Passenger car, N. Y. Central R. R., 80 ft. long*.	8,720
Sleeping car, Pullman or Wagner.....	15,000

The Knapp car ventilating system is being tried on a smoking car of the Missouri Pacific R. R., and is said to give satisfactory results. According to reports it consists of a T-shaped pipe, the vertical leg of which extends into the car and has openings near the floor, while the horizontal leg is on the car roof and is fitted with funnel-shaped ends. The air current through the horizontal pipe when the car is running induces an upward current in the vertical pipe. The need of an efficient system of car ventilation is very evident, and has been referred to several times in our columns.

For a street car motive power equal to or better than the trolley system the Metropolitan Traction Company offers a prize of $50,000, if the plan is presented to the New York State Board of Railway Commissioners before March, 1894. The Metropolitan company owns the Broadway surface and other lines in this city. The company asks the railway commissioners to decide upon the merits of any new system submitted; but the board answers that while it will co-operate in every practicable way it will not undertake to bestow the prize.

The drainage of New Orleans bids fair to be carried out some time in the near future, the city council having appropriated to this purpose the $700,000 recently received from the sale of the street railway franchises and the matter being under consideration by City Engineer L. W. Brown and an advisory board. Messrs. Rudolph Hering, M. Am. Soc. C. E., of New York city; B. M. Harrod, formerly City Engineer of New Orleans, and H. B. Richardson, M. Am. Soc. C. E., of New Orleans, were the three original members of the board, appointed last spring, which has since been increased to six members. A topographical survey of the city was begun last summer by Mr. Brown and will be completed as speedily as possible. Reports and plans recommending or providing more or less complete drainage schemes for the city were made in 1857, Mr. L. H. Pilie, then City Engineer; in 1868 by Mr. L. Surgi, then City Engineer; in 1869 by a commission of engineers appointed by the city council; in 1870 by Mr. W. H. Ball, then City Engineer. Between 1870 and 1874 some work was done, and possibly at other times, but at present there is no approach to an adequate system of drainage. A private company was a short time ago granted a franchise for a sewerage system.

A question involving both interstate and international water rights has arisen in connection with the proposed canal of the Colorado River Irrigation Co. This canal was to head in the Colorado River, nine miles above Yuma, Ariz., pass through a portion of California, then for some 45 miles in Lower California, to take advantage of grade and finally back into California. The people of Arizona claim that the canal is to head in that state and object to water being diverted from them, while the Mexicans claim that if the canal passes through their territory sufficient water must be given them to irrigate lands coming under it. The boundary of Arizona and California is in dispute, and it seems likely that legal steps must be taken to settle both the interstate and international questions involved.

The most serious railway accident of the week was caused by a washed out trestle on the Western New York & Pennsylvania R. R., Dec. 15. The trestle was a small one, crossing Herrick's Creek, near Dunkirk, N. Y., and the foundations had been washed out by a flood. The engine of a passenger train got across, but was derailed and went down the bank. The tender and three cars went down with the structure and were smashed. Five persons were killed and about seven injured.——Another serious accident was the derailment of a freight train on the Chesapeake & Ohio Southwestern Ry., near Muldraugh, Ky., Dec. 17, in which three persons were killed. The accident is said to have been caused by a broken truck, and 14 cars went down the bank.——A grate bar dropped from a locomotive derailed an engine and three cars on the Pittsburg, Virginia & Charleston R. R., near Bamford, Pa. The accident happened on a high bank alongside the Monongahela River, but fortunately the cars stopped on the edge of the bank. About 16 persons were more or less injured.

A bridge on the Missouri, Kansas & Texas Ry., near Smithville, Tex., broke down under a mixed train, Nov. 26. The engineer, fireman and a brakeman were hurt.——On Dec. 5 the north span of the bridge over Barren River, one mile north of Bowling Green, Ky., on the main line of the Louisville & Nashville R. R., broke down under a freight train and 13 cars were precipitated into the stream and burned. The engine and one car passed over in safety, while the caboose and one car stopped on the opposite side. No one was injured. The bridge was of iron and about 100 ft. long. The train was running at a low rate of speed and no cause is advanced for the failure of the structure.——The three-span bridge over the Tuscarawas River, at Trenton, O., was burned Dec. 16.——A bridge of three spans on the Adirondack R. R., at Poland, N. Y., was washed away by a flood Dec. 17.

An appalling falseworks disaster, resulting in the loss of probably a score of lives, occurred on Dec. 15 on the Louisville and Jeffersonville bridge, now being erected between Louisville, Ky., and Jeffersonville, Ind., *by* the Phoenix Bridge Co. The Louisville and Jeffersonville bridge was the largest at present under erection in this country, and consisted of six spans, the lengths of which, beginning at the Louisville end, were: Two 341 ft., one 350 ft., one 353 ft., one 350 ft., and one 210 ft., resting on masonry piers. The first three spans, in the above order, had been erected and the falseworks removed. Work was in progress on the fourth span, of which 475 ft., or all but a few panels, were in place, and, under which, of course, the falseworks remained. In erection, a traveler, about 104 ft. high, 20 ft. wide, and 80 ft. long, which ran on a track on the falseworks, was used, and this was located near the end of the span, where work was in progress. When the traveler was moved ahead for erecting the next to the last panel the falsework showed signs of weakness, and orders were immediately given to move it back and strengthen the falsework by additional bracing at the level of the pile caps. While the traveler was being unguyed and blocking being taken out to move back, a sudden squall struck it at an angle, twisted it to the right, and probably threw it off the traveler rails. Practically all the weight was thrown on one corner, and crushed down the bent and piling under it. Immediately on the giving way of this bent the whole structure collapsed. The falseworks consisted of rows of piles driven into the river bed about 30 ft. apart and projecting about 10 ft. above water, on which were erected trestle bents some 70 or 75 ft. high. The top of the falsework is stated to have been 95 ft. above the water, which would bring the top of the traveler about 200 ft. above. On the collapsed span about 51 men were at work, and all but about 20 went down with it. The latest reports give 7 dead, 16 missing, most of whom are supposed to be dead, and 14 more or less injured, two of which will probably die. In all, it is probable that over 20 lives were lost.

The 353-ft. span fell at 10:20 a. m., and nearly 10 hours later, or at 8:10 p. m., the adjoining 350-ft. span, the third from the Kentucky shore, which was practically completed and from under which the falseworks had been removed, fell into the river. We are informed that the span had been erected some three weeks, and all the material was in place. The floor system had been riveted complete. All the upper lateral bracing, portals, transverse bracing, upper chord joints, and intermediate post joints were bolted up, at least four-fifths of all the holes being filled with bolts, and riveting was progressing. The officers of the bridge company claim that the span was lifted from the piers by the force of the wind. No lives were lost from the fall of the second span. The loss to the bridge company is stated to be about $150,000. We shall publish full details of the accident, with illustrations of the falseworks, traveler and the iron trusses next week, the matter having been received too late for this issue, and shall reserve any further comment until then.

An unusually long span cableway has been furnished by the Lidgerwood Mfg. Co. to Smyth & Mumford, of Point Pleasant, W. Va., and has been erected over the Kanawha River, spanning the lock and dam which this firm are about to build at that point, and the quarry from which they will receive their stone. The span is 1,505½ ft. between the towers, one of which is 40 ft. and the other 100 ft. high, on the banks of the river. The main cable is 2½ ins. in diameter and the load provided for is four tons. The cableway is high enough above the water to permit the passage of steamers.

The final report on the New York and New Jersey bridge bill has now been submitted to the two branches of Congress, with an agreement of the conferees on the bill giving the older North River Bridge Co. the same privileges in regard to erecting piers in the river as would be granted by the pending bill. There is the further provision, however, that if the North River Co. puts a pier in the river, it is subject to the remainder of the bill governing the New York & New Jersey Co. The new bill strikes out the clause giving to the New York Commissioners of the Sinking Fund the solo power to authorize the laying of railway tracks on the New York approaches to the bridge.

Work on the Blackwell's Island bridge, the charter rights for which have been purchased by Mr. Austin Corbin, as noted in our issue of Dec. 7, will be begun as soon as the necessary preliminaries are finished, according to the statement of the engineers. The old plans for the bridge, which were given in the note referred to, will be slightly modified, shortening the length of the channel spans somewhat. In brief, the east approach will begin at a point on the Long Island R. R., near Sunnyside, and run to the east anchorage pier, some hundred feet inside the pier line. The second pier will be located just inside the pier line, the third across the east channel on the east shore of Blackwell's Island, the fourth on the west shore of Blackwell's Island, the fifth just inside the river line of New York city, at 64th St., and the sixth, the west anchorage pier, a few hundred feet inshore. From the sixth pier the west approach will cross over Avenue A to a point near 1st Ave., where it will divide, one line running north to 81st St. and another route to 44th St., and a third along 64th St. to connections with the 2d Ave. and 3d Ave. lines of the Manhattan Elevated R. R. It is stated that the plans for the bridge proper have not been decided upon, but its general features will be about as follows, as near as can be ascertained at present: A continuous cantilever structure over the two piers, on the island with arms projecting over the east and west channels, a cantilever structure on each shore pier with one arm reaching to the anchorage pier and one arm projecting over the channel, and a suspended truss connecting the above cantilevers and the middle, or inland, cantilevers, over each channel. The piers will be founded on rock, which is at no great depth at any point on the line of the bridge. The two channel spans will be about 850 ft. long, each. The bridge will carry two roadways, sidewalks, and either two or four railway tracks. In regard to the beginning of construction we are informed that the promoters are ready to begin work as soon as the preliminary negotiations are finished, but until these are further advanced no definite date can be set.

SPECIAL STRUCTURAL DETAILS OF THE OLD COLONY BUILDING, CHICAGO, ILL.

By Corydon T. Purdy, Chief Engineer.
(With inset.)

The Old Colony Building was described in Engineering News Feb. 16, 1893, in an article relating to some of the new office buildings in Chicago. The building is owned by Mr. Francis Bartlett, of Boston, who has placed the management of the entire business in the hands of Mr. Bryan Lathrop, of Chicago. It was designed by Messrs. Holabird & Roche, architects, and is being constructed by the Geo. A. Fuller Co. In construction it is probably as perfect a type of the steel skeleton building as any that has been erected. There are no self-supporting walls whatever in this structure, and all loads, brick, terra cotta, tile and stone in walls and floors are carried at each floor level on the steel frame. The special features of its construction pertain to the cantilever supports of the south end, to the lateral strength of the structure, to the column construction, and to the protection against fire. These have all attracted the attention of architects and engineers during the World's Fair months and are deserving of more than a passing notice.

When the planning of the building began, the support of the south end was the first really difficult problem encountered. The other three sides are bounded by streets, but this south end adjoins another property which is occupied by an old brick building six stories high with exterior walls and foundations built centrally upon party lines. A new party wall foundation extending somewhat over both lots, and large enough to carry its share of a new building on this neighboring property would, of course, have been the best and easiest solution of the problem. It could have been made without disturbing the old wall above the first floor, except to cut vertical openings in the outside of the wall for the steel columns which an old party wall contract permitted in any case. However, no agreement could be made to that end, and it became necessary to keep the foundations of the new building away from the old wall entirely or shorten the building. The cantilever construction was therefore adopted.

All the foundations in the building are made of steel beams and Portland cement concrete, several of them carrying three or more columns each. The areas are proportioned to 3,200 lbs. per sq. ft. of dead load, including the weight of the foundation. This limit of loading made it necessary to include three columns in each cantilever foundation, and owing to the larger loads on the columns next the street, Nos. 8 and 25, it was necessary to combine the interior ones, making six columns in all on one area. Fig. 1 shows the clay areas for all the foundations in the building. The part affected by these south footings, about one-third of the whole area covered, is shown in Fig. 2, with the arrangement of the iron and the exact proportions. Fig. 3 is a vertical section through the west pile, showing the old wall with its foundations, and Fig. 4 is a reproduction of one of the cantilever shop drawings.

Table I. shows the composition and amounts of the dead and live loads as figured for each column. The live load in these figures is taken at 100 lbs. per sq. ft. on the first floor and at 38 lbs. per sq. ft. on all other floors. The calculations of the foundation for the three columns relating to each cantilever are much alike and a description of the interior one may easily answer for all. The clay load was determined as shown in Table II.

TABLE II.—Showing Manner of Determining Load of Foundations on the Clay.

Column No.	Total load on basem't columns, lbs.	Live load, lbs.	Dead load, lbs.	Est. of dead load ex'm'd weight of f'dat'ns, lbs.	Dead load plus 10% wgt. of foundations, lbs.	Clay areas in sq. ft. at 3,200 lbs. per sq. ft.
9	903,300	190,400	712,900	114,060	826,960	258.4
10	990,640	323,700	666,940	106,710	773,650	241.8
11	1,355,450	330,440	896,010	143,360	1,039,370	324.8
22	1,292,010	375,000	917,010	146,730	1,063,730	332.4
23	990,640	323,700	666,940	106,710	773,650	241.8
24	903,300	190,400	712,900	114,060	826,960	258.4
Tot'l.	6,335,340	1,702,640	4,572,700	731,620	5,304,320	1,657.6

The additional load of the foundation itself is treated as though concentrated at column centers and in the same proportion as the loads carried by the columns. This is not theoretically correct though practically so, for the weight of the foundation, made as it is, is very evenly distributed, and therefore its center of gravity should correspond with the center of gravity of the loads. The actual weight of the foundation proved to be about 30,000 lbs. more than the estimated load, or about 20 lbs. per sq. ft. more than the 3,200 lbs. figured for.

Quite sufficient time was allowed for the preliminary study of this problem, but all the final calculations had to be made as rapidly as possible. The column loads were obtained and various efforts were made to fix upon a footing that would bring the centers of gravity of loads and resistance together, but none could be made on the basis of 3,200 lbs. per sq. ft. on the clay. The plan shown fails of this by about 5½ ins., the center of loading being that distance nearer the party wall than the center of gravity of the clay area. For various practical reasons, it seemed better to construct the work with this variation of centers than to recast all the foundations of the building to a basis which would not require such a variation or do any of the several other things that might have been done. After nine months, the average settlement of all the foundations in the building, but this one, is 4 3-16 ins., while the average settlement of this foundation is 5⅛ ins., and columns 9 and 24 on the small side of the footing have settled an inch more than the average of the other four. The latter fact may be due in some measure to the 5½ ins. variation in load and resistance centers, although columns 9 and 24 had received from 90% to 95% of their full load while the other four columns had not received more than 75% when these observations were taken. The explanation for the greater average settlement of the whole pile probably lies in the fact that this area is so completely and closely surrounded with the other foundations of the Old Colony Building and of the party wall of the adjoining building that most of the lines of resistance through the clay structure must necessarily be vertical, and all the advantage of its large perimeter is lost. It is a good illustration of the greater resistance to settling of a small isolated foundation as compared with any other in which the advantages of a large proportional perimeter are wanting. It is also another example of the extreme sensitiveness of the clay soil underlying the business portion of Chicago. This sensitiveness has sometimes been confounded with danger, but that is unreasonable. In this case the footing under the old party wall is loaded more than the new one, and the same is true of most of the old walls in the city. In justice to the building it should be said that these irregularities of settlement are very slight as compared with many large buildings in the city, and that they cannot be discovered even with an instrument in the finish of the building.

The quantities used in calculating the iron in the foundation are the same as those used for calculating the section of the basement columns. This is the reasonable course, though it involves various difficulties. If it is advisable to allow for 330,000 lbs. of live load on basement column 10, for example, the beams and girder that support that column should be strong enough to carry the same load, and it would be wasteful to make them stronger than that. However, the use of a different set of loads at column centers disturbs the equilibrium of the pile and makes all the points of no-shear, and consequently the determination of maximum bending moments, somewhat indefinite.

Supposing the reaction of the loads to be equally distributed, the points along the line connecting columns 22, 23 and 24, for example, at which the shear is zero, are as follows:

1. Between columns 22 and 23, 14 ft. 3 ins. from column 22.
2. Between columns 23 and 24, 11 ft. 6⅝ ins. from column 23.
3. Nearest column 23, 2⅝ ins. from column 23 toward column 24.

and the moments at each of these points are:

1. Between columns 22 and 23, 5,406,000 ft.-lbs.
2. Between columns 23 and 24, 4,652,000 ft.-lbs.
3. Nearest column 23, 3,551,000 ft.-lbs.

There are other moments in these beams, but they are unimportant and are therefore omitted.

The greatest moment, it will be noted, occurs between columns 22 and 23. The greater proportion of live load is also at this end of the foundation. If the basement column load on column 22 should be considered as equally distributed over that portion of the whole area allowed for it in the second table of figures given above, this point of no-shear would be moved about 3 ins. nearer the column 22, and the moment would be reduced to about 5,258,000 lbs. If the moment should be figured from the clay load, it would be much greater, and unreasonably so. Fig. 2 shows the iron actually used. This depended in the end very much on practical considerations, as is often the case. Twenty-seven beams were used and not more, because a larger number could not be laid well in the given area. The, 15-in. beams were desirable because the 20-in. would raise the iron too high above the established floor line in the basement, and beams weighing 90 lbs. per ft. were used because none heavier could at that time be obtained. The moment of resistance is not quite as great as desired, for a moment of 5,300,000 lbs. induces a fiber strain of about 21,000 lbs. per sq. in. of outmost fiber. However, as the 375,000 lbs. of live load on column 22 will come on the foundation rarely, if ever, it seemed allowable. The regular dead load, that is, the weight of the building itself, will not strain these beams more than 14,000 lbs. per sq. in. of outer fiber, which is not a high strain for the constant one. Though the bending moment between columns 23 and 24 is less, for practical reasons it seemed better to add additional beams for the uncovered area between these columns rather than to cut some of the long beams, and so change the distribution, as is sometimes done.

The lateral strength of this building has been provided for by four sets of portal arches reaching from the foundations to the roof. To the credit of all concerned in the construction, it may be recorded that while they very reasonably required that the lateral bracing should not be obtrusive or ruinous to renting interests, its importance was conceded from the first, and every plan made for the arrangement of the interior of the building, even before anything was done in designing the steel frame, was made with this point in view. The position which it was to occupy was fixed early in the work, but the portal construction was not decided upon until after the contract was let, and it was determined to use Phoenix columns. The arrangement under which the contract was made was a combination of arches and tension bars, and the change was made partially to save the eccentric load it brought on the columns, but largely for the advantage the new system would have in the arrangement of the rooms. Fig. 5 shows a cross-section of the building through columns 6, 11, 22 and 27, and two sets of these portal braces in outline. Two other sets similarly designed are placed between columns the same distance from the other end of the building. Fig.

TABLE I.—Composition and Amounts of Dead and Live Loads on Each Column.

	Columns 8 and 25. Lbs.	Columns 7 and 26. Lbs.	Columns 9 and 24. Lbs.	Columns 10 and 23. Lbs.	Column 11. Lbs.	Column 22. Lbs.
Dead floor load	276,029	404,840	321,560	712,680	753,040	783,690
Live " "	95,170	181,790	165,730	348,370	339,440	375,000
Weight of column and covering	55,570	55,570	55,570	55,570	55,570	55,570
" spandrel walls	166,400	251,450	137,720			
" piers	186,750	257,060	41,920			
" windows	11,490	16,710	8,750			
" tile walls	25,520		51,070		74,970	74,970
Dead sidewalk load	6,250	9,250				
Live " "	11,360	16,820				
Effect of cantilever, dead	+ 111,980	— 111,980	+ 101,310	— 101,310		
" " " live	+ 14 370	— 14,370	+ 24,670	— 24,670		
Elevators						2,870
Total load	910,940	1,067,140	903,3 0	990,640	1,255,430	1,292,010

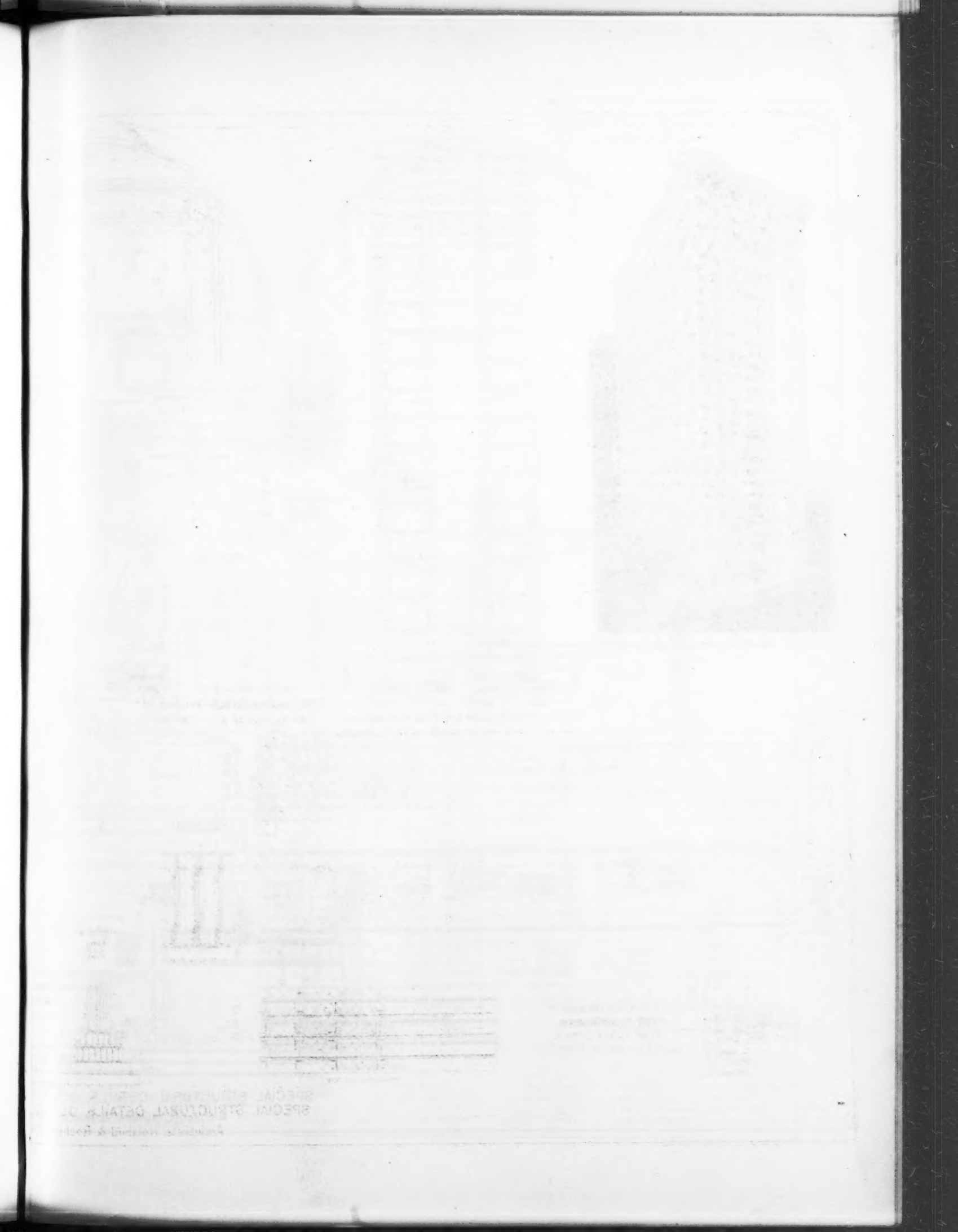


FIG. 11.—VIEW OF OLD COLONY BUILDING.

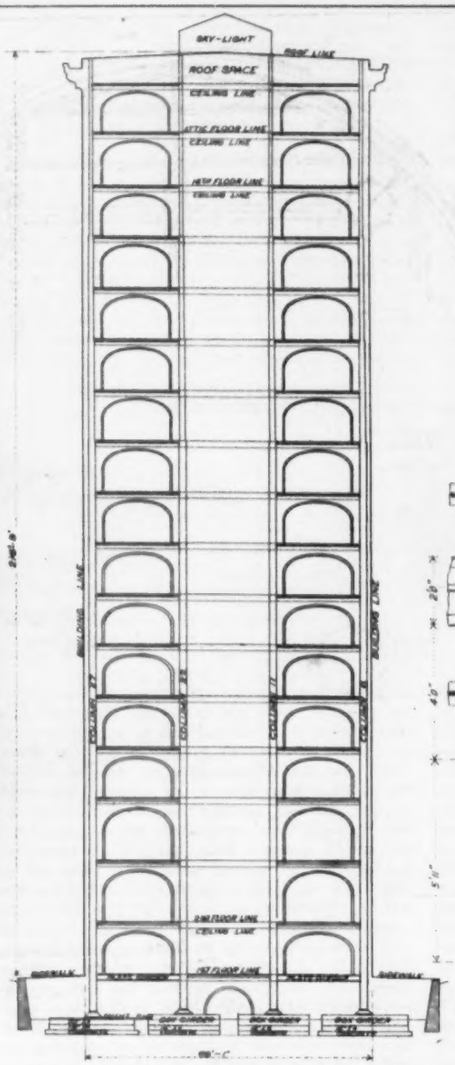
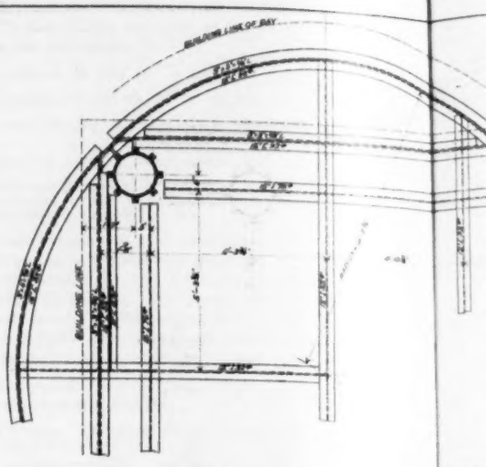


FIG. 5.—CROSS SECTION SHOWING WIND BRACING.



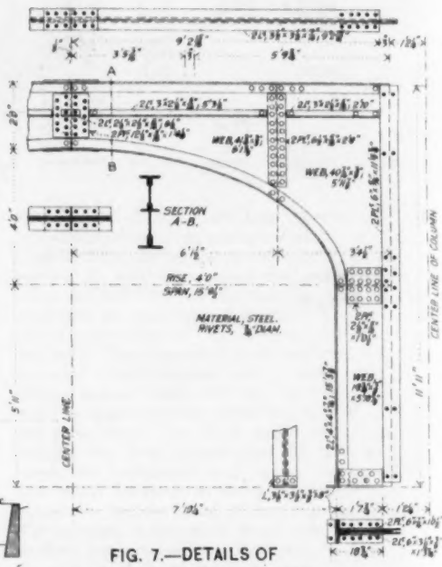


FIG. 7.—DETAILS OF CONSTRUCTION OF WIND BRACING.

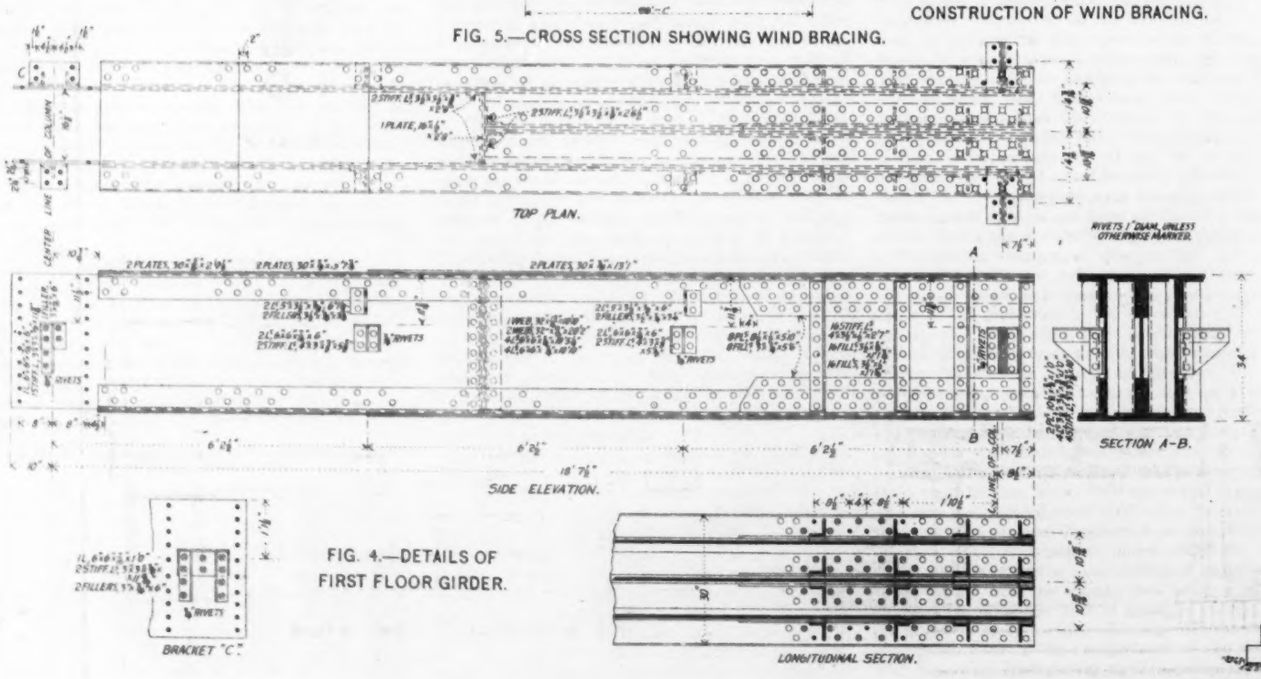


FIG. 4.—DETAILS OF FIRST FLOOR GIRDER.

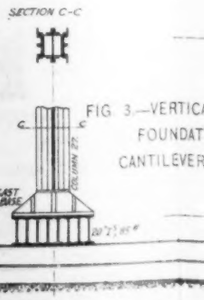


FIG. 3.—VERTICA
FOUNDAT
CANTILEVER

SPECIAL STRUCTURAL DETAILS, OLD COLO

Architects, Holabird & Roche; Engin

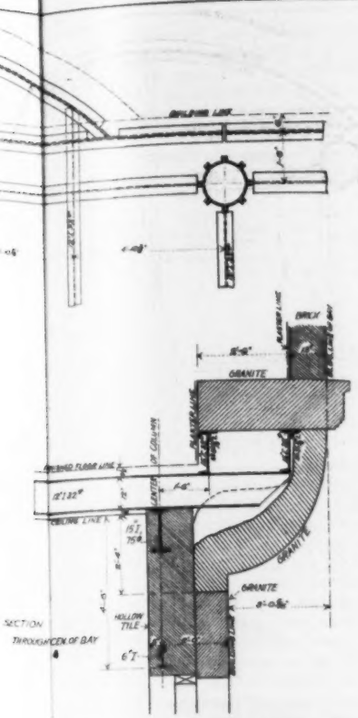


FIG. 9.—DETAILS OF FRAMING, THIRD FLOOR BAY WINDOWS.

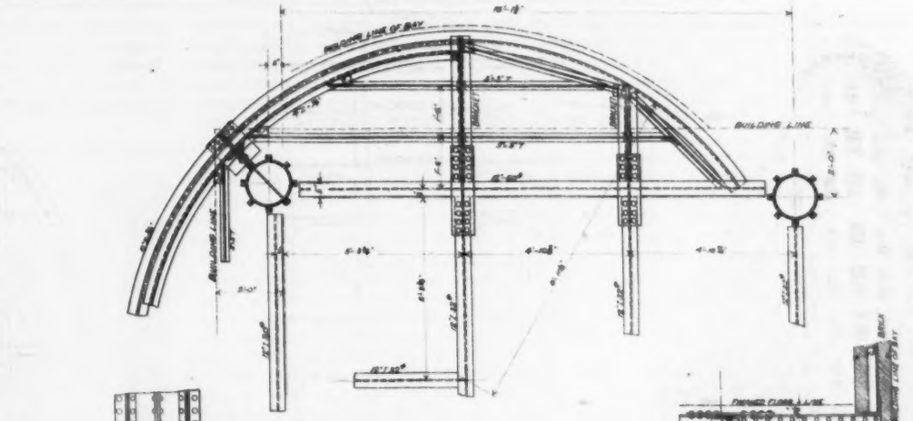


FIG. 10.—DETAILS OF FRAMING, TYPICAL BAY WINDOW.

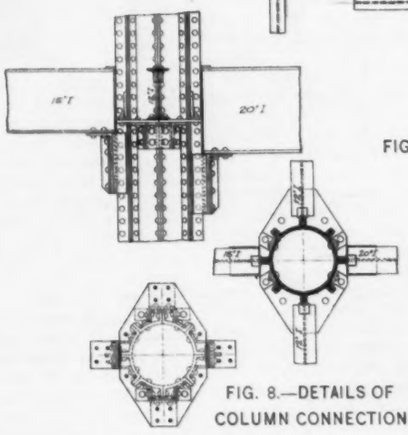


FIG. 8.—DETAILS OF COLUMN CONNECTION.

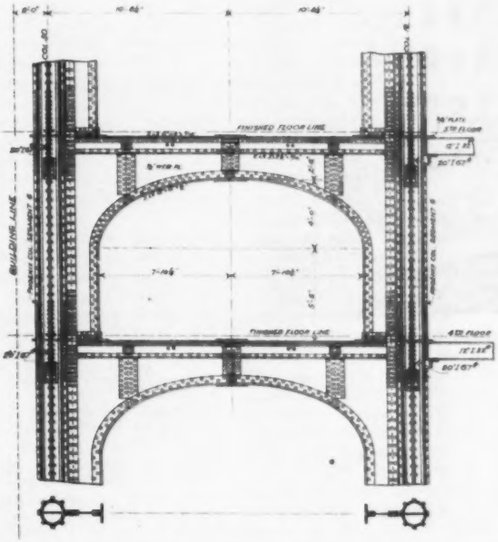


FIG. 6.—ELEVATION SHOWING CONNECTIONS OF WIND BRACING WITH COLUMNS.

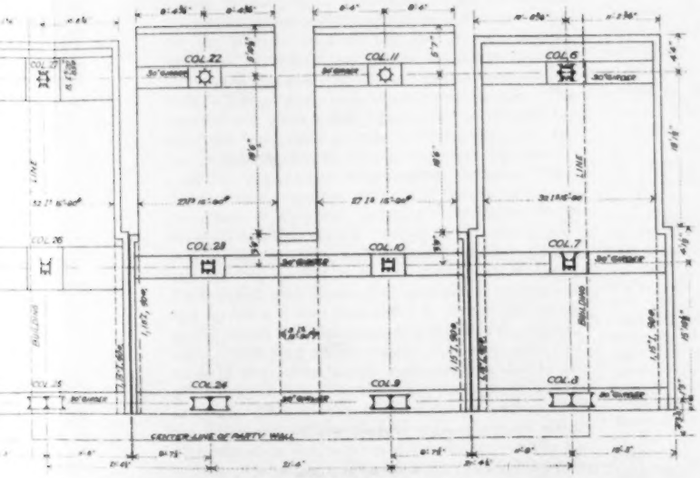
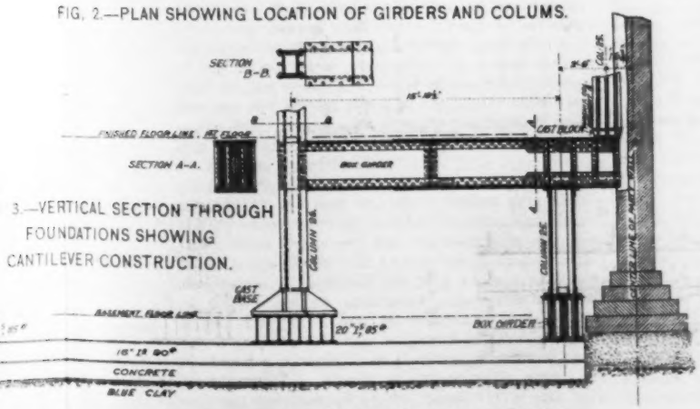


FIG. 2.—PLAN SHOWING LOCATION OF GIRDERS AND COLUMS.



3.—VERTICAL SECTION THROUGH FOUNDATIONS SHOWING CANTILEVER CONSTRUCTION.

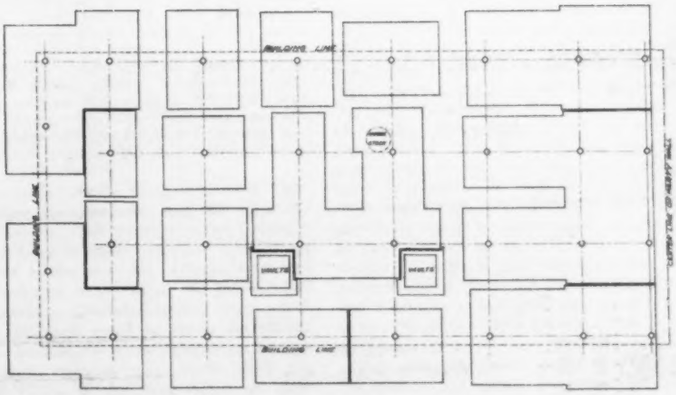
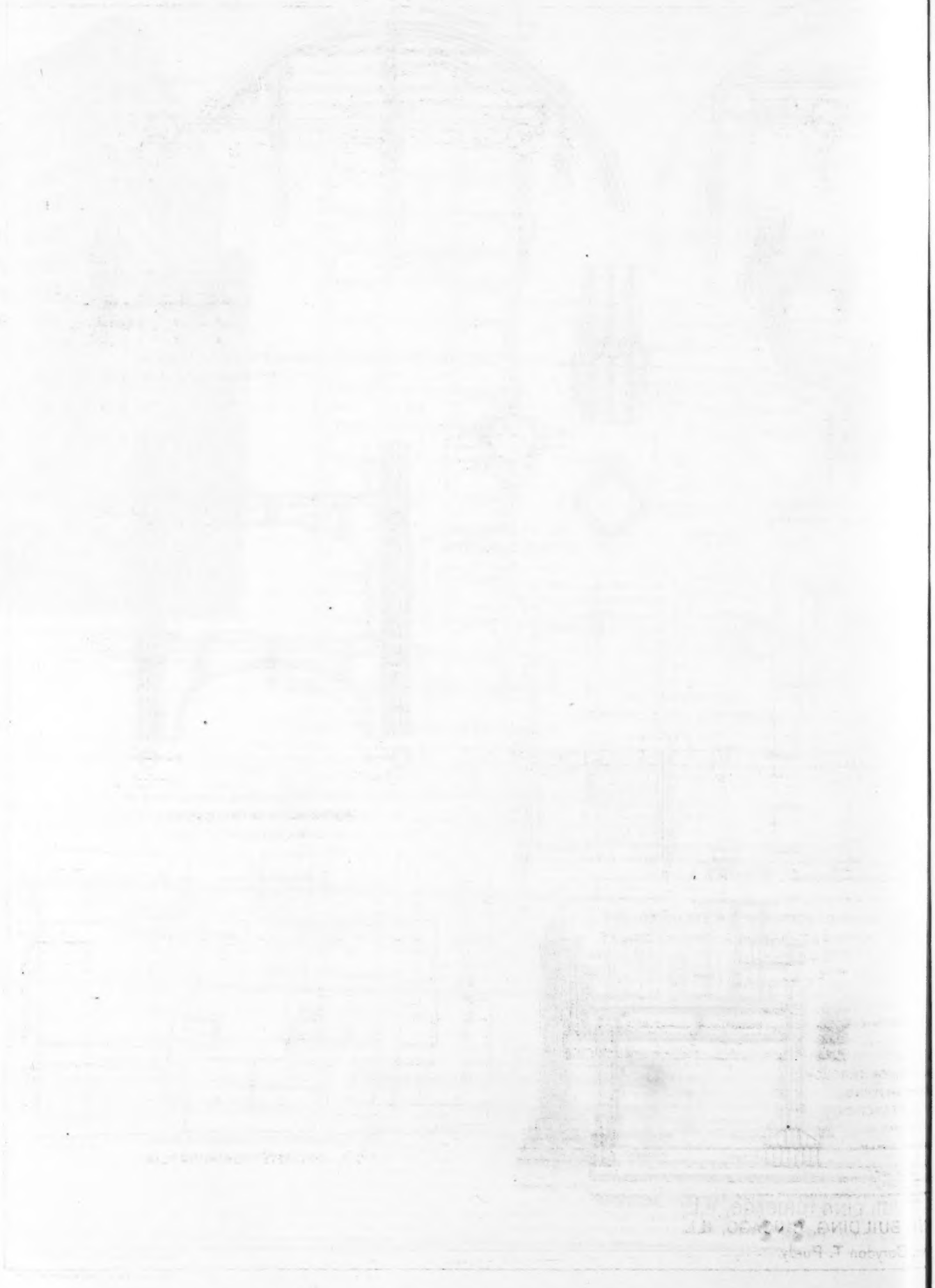


FIG. 1.—CONCRETE FOUNDATION PLAN.

LD COLONY BUILDING, CHICAGO, ILL.

ne; Engineer, Corydon T. Purdy.

CHAS. HART & SONS, LITH., 96 VESEY ST., N. Y.



6 shows one of these arches in full with all its connections, and Fig. 7 shows a shop drawing of one piece as it was delivered for erection. The accumulated shears which each of the four sets is designed to resist and the resultant column strains are shown in Table III.

TABLE III.—Showing Shears and Column Strains Due to Wind Bracing.

Levels.	Shears, lbs.	Column strains, lbs.
Roof and ceiling	7 860	4,220
Attic floor	19,580	15,660
16th floor	31,620	33,390
15th "	43,570	57,820
14th "	55,700	89,100
13 h "	67,900	127,170
12th "	80,170	171,990
11th "	91,840	223,490
10th "	103,610	281,600
9th "	115,220	346,210
8th "	126,640	417,240
7th "	137,800	494,510
6th "	148,600	577,770
5th "	158,930	666,900
4th "	169,110	781,320
3d "	179,040	903,180
2d "	185 120	1,006,930

The strains in the third row of figures apply to the columns carrying the floors given in the same line in the first row of figures. They increase the regular load on the column away from the wind and reduce the regular load on the column next the wind. It matters little how the inital loads were obtained, so long as they were properly proportioned, for their full application would practically reduce the regular working column load, that is, the full dead load and a small live load, to zero. More than this would, of course, lift the columns. They are equivalent to a pressure of about 27 lbs. per sq. ft. over the entire surface of one side of the building at one time. The inertia of the building, the strength of exterior walls, and the stiffness of connections, especially of beams to columns, and the strength of partitions are all supplementary to this bracing and probably make it laterally the strongest steel-constructed building of similar proportions in the world. Each portal was calculated independently of those above or below, for the sections of both top and bottom flanges, thickness of webs, cross shear on rivets connecting curved flanges, and for splices and connections both to the columns and to adjoining portals. The calculations were made practically as though the two halves of each portal were connected in the top or straight flange with an ordinary pin connection. In the actual construction, however, they were riveted together to secure simplicity in detail, ease of erection, increased resistance to vibration, a stiffer member which counts for a good deal during erection, and because it carries a floor, and to that extent must be treated as a beam. Each portal was designed in two pieces instead of one, because it was impossible to ship them whole, and it would have been much more difficult to erect them. The long splice outside of the column was made in two pieces for the same reasons, and to admit of its erection after the other iron around it was in place. This proved a fortunate precaution, for the delivering of the portals was extremely slow. The splices in the web on each side are in the interests of economy. The straight $3 \times 2\frac{1}{2} \times 5\text{-}16$-in. angles are flush with the bottom of the regular 12-in. floor beams, and are so arranged that they can carry the tile floor arch. Each leg is attached to the portal below with three lug angles and a rivet section equal to one-half of the initial shear. The top and bottom plates in the center have only a few rivets, but enough to make the member good as a beam supporting a small floor area and to ease the erection somewhat.

adaptability. It may be put in almost any build- adaptibility. It may be put in almost any building somewhere without a serious injury to the structure. Even the stores and banking-rooms on the lower floors of the Old Colony are arranged with the arches, so there will not be a serious reduction of income nor an unpleasant appearance in the finish. The portal may be fireproofed so that the space on each side can be joined in one room, or if they are covered in a partition, doorways may be cut through, except at the extreme sides, to suit the arrangement of the rooms. It is also believed that it will stiffen the building more than any system of tension rods against the minor vibrations to which Chicago buildings in particular are subjected. These vibrations are caused by street traffic or anything else that gives the neighboring ground a jar, and they are felt in Chicago possibly more than elsewhere on account of the very mobile nature of the clay soil that underlies the entire business section of the city.

In point of cost they will also compare favorably with any system of rod bracing, especially if the rods are designed so that doorways may be constructed through the partitions that cover them. In this respect the rods are at a disadvantage in having to be doubled to resist wind from both ways, while all the metal in the portals is strained from whichever way the wind may blow. When these tension rods are connected to the struts as they generally are, the column strains they induce are eccentric, while the portal construction detailed as it is in this case practically eliminates eccentricity of column strains from the top to the bottom of the system. In the Old Colony Building, on these accounts and others, the arches cost less than the tension bars as they were first designed.

The lightest metal used in the arches near the top of the building where the shears are so small is 5-16 in. thick, the flange angles being $3 \times 3 \times 5\text{-}16$ ins. The design calls for a great quantity of field rivets, but it was such easy work that the field riveting was not as costly as might be expected. The design is entirely new with this building and the Monadnock, it being put into both buildings at the same time. The whole problem of bracing buildings is hedged about with difficulties and limitations, so that real improvements in methods of accomplishing it must necessarily be slow. The designing of the steel arch in this way was no exception to this condition; it was the result of a process of evolution, in which various intermediate steps have been practically tried and found wanting. In the Old Colony Building it is a complete success, so complete, in fact, that it may work a new era in the construction of steel buildings.

Reference has already been made to the use of Phoenix columns. A new type of construction for the connection of the beams to the columns was designed for use in this building, and it has a bit of history. The specifications relating to the detailing of the columns under which the contract was let were, in part, as follows:

"Beams connecting to columns shall have four rivets in the bottom flange wherever the details of the columns will permit of that number, and in all cases the beams must extend as closely as possible to the axis of the column. The top connection angles connecting the beams to the columns shall be omitted on all floors, and bent strips of heavy sheet iron and especially designed wedges must be drvien in at the end of each beam in place of the top connection angle until the clearance between the end of beams and the metal of the column is tightly closed. In case the flange of the column will not serve to hold these wedges in place, some other means must be employed to serve the same purpose. All columns shall be provided with cap plates ¾ in. thick, and, in general, the columns shall be cut so the floor beams or girders shall rest directly upon them; dependence, however, must not be placed entirely on the shear of the plate to carry the beams. . . . . Columns shall be connected to columns, when possible, by at least four rivets passing through the cap plate, and two lug angles, one on each column. All rivets used in connecting beams to columns must pass through the lug angles connected directly to the columns, and riveting such connections to the cap plate without a lug angle will not be allowed."

The Z-bar columns can be designed so as to fully answer to these specifications, and the Geo. A. Fuller Co. sublet the steel contract to the Carnegie Steel Co. with Z-bar columns specified. Then came the Homestead strike, and the contract was canceled; Z-bar columns were out of the market and out of the question. Phoenix columns were available, and if the work could be made reasonably simple could be had at an acceptable price per pound. A new contract was made with the Phoenix Iron Co. with the expectation on their part that no unusual cost would be involved in the detailing, which was to be done by the Geo. A. Fuller Co. It was also assumed that the Phoenix columns could be made to conform to all the specifications without adding to the cost per pound or to the total tonnage. In fact, however, the ordinary construction of Phoenix columns did not conform to the specifications, and the only system of connections in use to any extent, which it was hoped could be made to apply, was that recommended by the Phoenix Iron Co., of Phoenixville, Pa., involving the large use of gusset plates and fillers. There were, however, immediately three objections: First, the Phoenix company objected on the score of cost, it being too great for the price they were to receive per pound; second, it would have added materially to the tonnage; and third, the great irregularity of beams, both in the spandrels and in the floors, both as to height and as to position relative to the axes of the columns, really made even that system seem impracticable.

The problem was studied both at Phoenixville and in Chicago, and it seemed as if there were insurmountable obstacles to every arrangement that could be devised to meet all the conditions. It seemed as if the best construction would have to yield place to commercial considerations as it has so often done. Finally, after some weeks a general scheme was devised for these connections that practically met all the requirements, and it was adopted with the hearty approval of all concerned. An illustration of it is given in Fig. 8. It could not be made to apply to all cases, but it could to nearly all, and more than 1,000 of them were used in the building. In a few cases where heavy spandrel loads had to be carried 16 or 18 ins. from the center of the column, gusset plates and fillers were introduced between the Phoenix sections. The gusset plate without the fillers was also used in all wind bracing columns to connect to the portals, as shown in Fig. 6. The gusset plates in all cases extended the entire length of the column. These were, however, the exceptions and the device shown in Fig. 8 was the rule. The most important part of this connection is the bent plate riveted directly to the body of the column. Before the device was adopted full-sized sections of all the different columns that would be used in the building were carefully drawn and the plates were fitted to these sections under all the varying conditions. It was found that not more than six different kinds would be required. Dies were cast by the Phoenix company for each of these six patterns, to work under the steam hammer, and the plates were stamped out in quantities at a time from lists furnished from Chicago, giving the number and lengths of each pattern, in advance of working drawings. The lug angles applied to the sides of the bent plates were used for column connections and that in front to secure the beam. When the cap plate projected over the connection it fulfilled no other office than that of a filler and where it was necessary to have the connection lower, the plate was cut off flush with the column. All 12-in. beams and smaller sizes were flush on the bottom and all 15-in. or 20-in. girder beams were flush on the top with the 12-in. beams, while spandrel beams varied both ways. This irregularity was a fortunate condition on the small columns, for it permitted the short bent plate to fasten above the longer one to the same Phoenix segment. Many of the beams connected to the columns several inches from the axes, or entirely to one side, but these conditions applied in such cases as well as any could have done. The connection of column to column is somewhat indirect, but it is not so bad as connecting the columns through the beams as has so often been done. All in all the detail has proved a complete success. Mr. Amory Coffin, the Chief Engineer of the Phoenix Iron Co., has repeatedly stated both in conversation and in letters, that it was very satisfactory to their people, that it was comparatively cheap in construction and that he would be glad to have the same detail specified in future work. It certainly has added a large element of solidity and stiffness to the Old Colony Building and it seems as if it must give an increased value to the Phoenix column for use in all building construction.

The remaining point which it was proposed to describe in this article concerned the precautions that were taken to protect the steelwork against fire. They were unusual. The rule was that no structural metal should be exposed, but that all should be covered in some way. It is for the exterior columns, however, that the exceptional precaution has been taken. Each of these columns is placed 2 ft. back from the street lines and is entirely surrounded with a 3-in. hollow tile wall which in turn is covered on three sides with a solid

brick wall not less than 13 ins. thick. This is in great contrast with columns placed 12 ins. from the street lines, and protected from any outside heat by only 4 or 5 ins. of limestone, or granite, or even of brick, all of which is so common in every city where steel buildings are built. The astonishing power of steel columns to retain their strength when heated was demonstrated in the burning of the Athletic Club Building, in Chicago, about a year ago (Eng. News, Dec. 1, 1892), when Z-bar columns over 20 ft. long carrying large portions of the building, stood in the midst of the hottest fire which probably ever occurred in a steel building, and stripped entirely of their covering, they kept their places practically, without twisting or bending. Yet this ought not to be taken as an assurance that steel will always retain its rigidity under such circumstances. The Old Colony building will cost $1,250,000, and by and by 3,000 people or more will receive their mail daily within its walls If some day in some unforeseen conditions, a great fire should materially weaken some of its main columns, the calamity might be awful, and it is worth more than a passing notice that architects and builders are constantly putting more safeguards against disasters of this sort into their work.

LOCOMOTIVE SHOPS OF THE NEW YORK CENTRAL R. R., AT DEPEW, N. Y.

The new industrial town of Depew, N. Y., founded a little more than a year ago, is situated about nine miles east of Buffalo, near the village of Grimesville, and already several large works have been erected, of which the most important

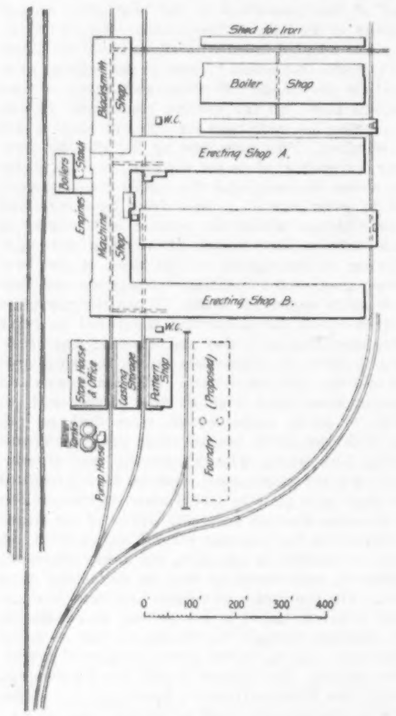


Fig. 1. Plan of Locomotive Shops of New York Central R. R. at Depew, N. Y.

are the New York Central & Hudson River R. R. Co.'s locomotive shops, now in operation. Fig. 1 is a general plan of the works, showing the track arrangements and the connection with the four-track main line, by which it will be seen that the work is well concentrated and the shops are arranged to give a direct and regular progress of the work. Further details of the plan of the main shops are shown in Fig. 2, by which it will be seen that the boiler shop has 20 tracks running to a transfer table, operated by hand power, and each of the two erecting shops has 24 erecting pits, all served by a transfer table of 100 tons capacity between the shops, operated by a 20-HP. United States Co. electric motor of 220 volts. The pit for the transfer table of the boiler shop is 30 ft. wide and 387 ft. 10 ins. long, while that for the erecting shops is 80 ft. wide and 527 ft. 2 ins. long. Each of the two erecting shops has an overhead traveling crane of the Morgan Engineering Co.'s manufacture, of 30 tons capacity, each operated by five Thomson-Houston electric motors. The current is furnished by two Thomson-Houston

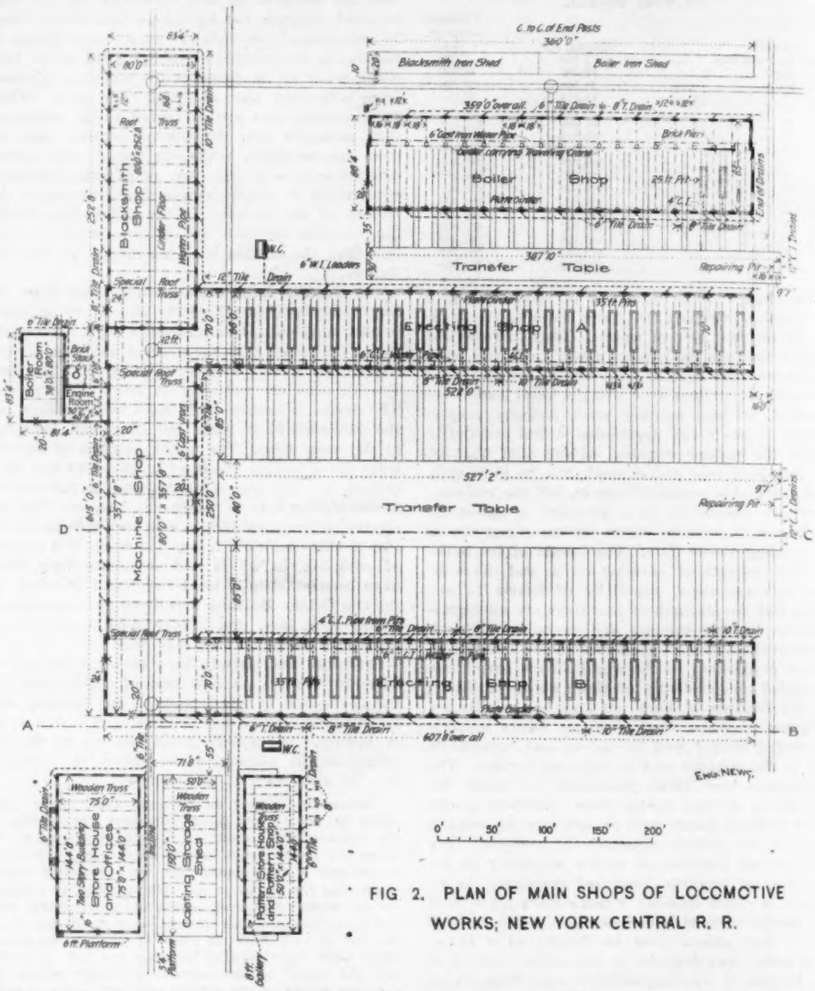


FIG 2. PLAN OF MAIN SHOPS OF LOCOMOTIVE WORKS; NEW YORK CENTRAL R. R.

90-HP. dynamos. Provision is made in the boiler shop for placing an electric crane at a later date.

Fig. 3 shows the general elevation, which is very plain and simple, with ample window and skylight area. The buildings are of brick, with steel roof trusses and monitor roofs for ventilation. All the work is done on the main floors, there being no galleries. The office and storage building, however, has two stories. It will be seen by Fig. 2 that particular attention has been paid to the drainage and water supply. The power plant consists of a Webster, Camp & Lane Machine Co.'s engine of 200 HP., and four horizontal tubular boilers, 6½ ft. diameter and 16 ft. long, with 110 tubes, 3½ ins. diameter. The boiler capacity aggregates 500 HP. The dimensions of the shops are as follows:

Erecting shops (two)	552 ft.	0 ins.	× 70 ft
Machine shop	357 "	8 "	× 80 "
Blacksmith shop	232 "	8 "	× 80 "
Boiler shop	339 "	0 "	× 85 "
Iron shed	36 "	0 "	× 20 "
Pattern shop and store	144 "	0 "	× 50 "
Casting storage shed	150 "	0 "	× 50 "
Office and storehouse	144 "	0 "	× 75 "
Engine-house	40 "	4 "	× 30 "
Boiler-house	80 "	0 "	× 58 "

The general arrangement and scope of these shops was designed by Mr. Wm. Buchanan, Superintendent of Motive Power and Rolling Stock. The working plans of the buildings and yard were prepared, and the execution of their construction carried out, under the instruction and supervision of the Chief Engineer, Mr. Walter Katte, M. Am. Soc. C. E. The details of the architectural and structural ironwork constructions were worked out under the supervision of the chief engineer by Mr. J. D. Fouquet and Mr. Geo. H. Thomson, the heads of those departments in the chief engineer's office. The general contractor for the buildings was Mr. Wm. R. Havens, of Buffalo, and the structural steel and ironwork of the roof trusses was made by the Rochester Bridge & Iron Works. The works cost about $600,000, and will give employment to some 1,500 men.

MISCELLANEOUS EXHIBITS AT THE COLUMBIAN EXPOSITION.

Conveying Plant.

The numerous applications of link belt conveyors were well illustrated by the exhibits made of this system of handling materials. The Link Belt Machinery Co., of Chicago, showed different styles of link belt chains, including its specialty, the Dodge chain with detachable links and wearing pieces. To these chains are attached various forms of buckets or scrapers, according to the nature of the material to be handled. Coal may be handled in either way, and the use of scrapers at a railway coaling station was described and illustrated in our issue of Nov. 10, 1892. Vertical hoists for factories, warehouses, etc., have continuously traveling chains fitted with platforms or carriers and made with automatic loading and discharging devices. Horizontal conveyors for packages, etc., are largely used in factories, breweries, etc., for carrying packages from one department to another, and for these conveyors slides are preferred to rollers. A model of a phosphate rock elevating plant shows the chain of buckets given a twist in rising vertically from the loading to the discharging level, so as to keep the buckets right side up in traveling across the upper side of the trestle to the discharging shoot. The

C. W. Hunt Co., of New York, exhibited a coal elevator and noiseless bucket conveyors for coaling stations, etc. The Jeffrey Mfg. Co., of Columbus, O., showed tile and package elevators, barrel and sack hoists, and horizontal traveling conveyors for packages. The latter has a continuous platform with small wheels or rollers, but many of the rollers do not turn, easily getting jammed by dust and dirt. The Caldwell & Son Co., of Chicago, exhibited screw conveyors, consisting of a shaft

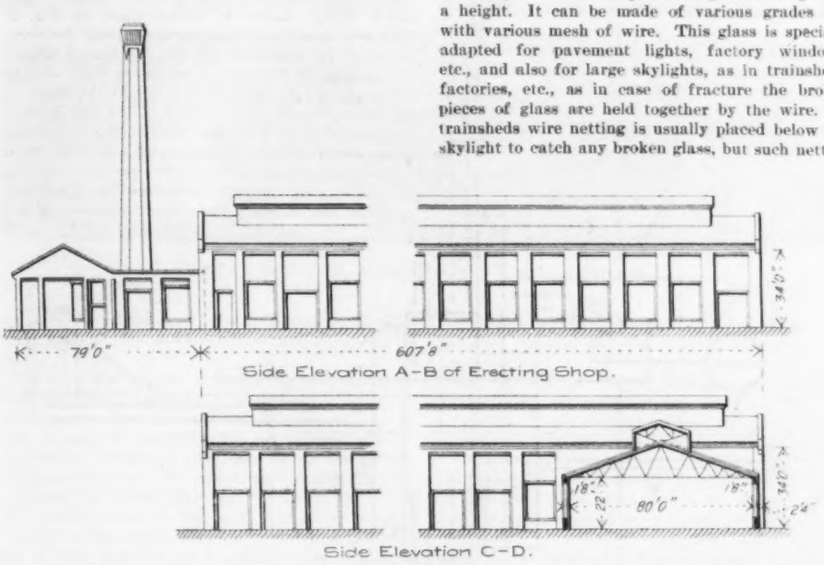


FIG. 3 GENERAL ELEVATIONS OF LOCOMOTIVE SHOPS OF NEW YORK CENTRAL R. R.

with a continuous spiral blade riveted to it. These conveyors run in a trough. The Harrison conveyor exhibited by Borden, Selleck & Co., of Chicago, Ill., consists of ling chains with scrapers or carriers attached, which travel in a trough. It is used for handling grain, coal, tan bark, etc.

Wire and Wire Rope.

The John A. Roebling & Sons Co., of Trenton, N. J., had an extensive and interesting exhibit of wire and wire rope, and showed four sections of the Brooklyn Bridge main cables, each of which is composed of 6,000 parallel No. 7 galvanized wires and has an ultimate strength of 22,300,000 lbs. There were also samples of the wire used for the long-distance telephone line from Boston to Chicago (the route touching Providence, New York, Newark, Harrisburg, Cleveland, Toledo and South Bend). The line is a metallic circuit consisting of two No. 8 B. W. G. hard drawn copper wires, each 1,200 miles long (2,400 miles in all), weighing 435 lbs. to the mile, or 1,044,000 lbs. for the entire line. A striking feature of the exhibit was a huge reel, upon which was wound a traction cable for the Third Ave. cable railway in New York. The cable was 1½ ins. diameter, 36,850 ft. long, and weighed 143,000 lbs. Grip and carrying pulleys for cable railways were also shown. Washburn & Moen, of Waukegan, Ill., had an extensive exhibit ranging from fine wires and small wire strands to heavy cables for bridge and hoisting purposes. In some of these each strand is a separate wire, while in others the strands are of smaller ropes, and where special flexibility is required, each of the rope strands has a hemp core and these strands are coiled round the hemp core of the cable. Twisted and barbed fence wire, and various kinds of copper, iron and steel wire were shown, together with specimens of the high-grade steel manufactured by this company for surgical instruments, etc. The Trenton Iron Co., of Trenton, N. J., had in its exhibit specimens of single wires and piano wire of high tensile strength, and also specimens of wire cables for various purposes. The California Wire Works, San Francisco, Cal., showed plain wire, barbed wire for fencing, flat and round wire ropes and cables for overhead tramways (Eng. News, Nov. 9, 1893), hoisting purposes, etc.

Wire Glass.

The American Wire Glass Mfg. Co., of Tacony, Pa., exhibited several specimens of wire glass, consisting of steel wire netting embedded in sheets of glass of any desired thickness (Eng. News, April 20, 1893, and March 19, 1892). Some of the specimens exhibited had been broken by hammers, so as to show the strength of the material and the cohesion of the broken pieces, which avoids the danger incident to pieces of glass falling from a height. It can be made of various grades and with various mesh of wire. This glass is specially adapted for pavement lights, factory windows, etc., and also for large skylights, as in trainsheds, factories, etc., as in case of fracture the broken pieces of glass are held together by the wire. In trainsheds wire netting is usually placed below the skylight to catch any broken glass, but such netting obstructs the cleaning of the skylight and is liable to corrosion, while the wire in the glass is effectually protected from the destructive influence of air, smoke and gas. The company has furnished about 300 small sheets of its thinnest glass to the New York Central R. R. as a trial order, and it reports that the glass has met with the approval of many architects. The works have a daily capacity of 500 sq. ft., and though they have only been in operation for a few months, the company has placed some 200,000 sq. ft., which has given general satisfaction. The glass is made either ribbed or plain and the prices for sheets up to 24×84 ins. range from 25 cts. per sq. ft. for ¼-in. to 50 cts. for ¾-in. glass. Special sheets can be rolled as large as 4×10 ft., but there seems to be little demand for these very large sizes. Tests made by the Pennsylvania R. R. at Altoona, Pa., showed that the chance of the material falling to pieces under severe and continued changes of temperature are very small, and that even if cracks should lead to corrosion of the wire, there are so many points of attachment that the chances of a piece dropping out are very small. This glass is used on the U. S. cruiser "New York," built at the Cramp shipyards, in Philadelphia, and will be specified for use in public buildings by the Supervising Architect of the Treasury Department. It is also used in the Broad St. trainshed of the Pennsylvania R. R., at Philadelphia, the Boston & Maine R. R. trainshed in Boston, the new Congressional Library, and other public buildings. Arrangements will be made for its manufacture in Europe, and several foreign orders have already been received. The company is the sole manufacturer of wire glass products in this country. President, Thomas M. Hammett; Secretary, Frank Shuman.

Petroleum.

The Standard Oil Co. had in the Mining Building a large exhibit of various grades of oils, crude and refined, shown to advantage in glass jars, and at night the exhibit was lighted by numerous handsome lamps. A model of a tank car of 125 barrels capacity was shown, together with a model of one of the company's ocean tank steamers for conveying crude or refined oil in bulk. This vessel has 14 compartments, with an aggregate capacity of 1,200,000 barrels of oil, and they can be separated or connected as desired. The cargo can be loaded or discharged by pumps in seven hours. The ship is 310 ft. long, 40 ft. beam, 28 ft. depth of hold, 22 ft. draft, 2,553 tonnage measurement, with a capacity of 3,500 tons. It is driven by triple expansion engines making 75 revolutions per minute, and has a sea speed of ten knots. It carries a crew of 35 in all, and can make eight round trips in twelve months. Geological sections of the oil regions were also shown, and the daily product of petroleum in the United States was given as follows:

Illuminating oils	105,000 barrels	75%
Lubricating oils	14,000 "	10%
Naphtha and fuel oils	20,300 "	14½%
Coke	700 "	½%
Total	140,000 "	

Railway Water Stations.

There were two completely equipped locomotive or railway water stations. One of these was an exhibit of the United States Wind Engine & Pump Co., of Batavia, Ill., and consisted of a wooden tank supported on twelve light built-up iron columns, and supplied either by one of the company's wind engines (Eng. News, Nov. 2) or by a Worthington pumping engine (10×6×10 ins.) which, with a vertical boiler of the Kewanee Boiler Co., Kewanee, Ill., was placed in a regular pump house. The other station was installed by Fairbanks, Morse & Co., of Chicago, and consisted of a wooden tank 16 ft. deep and 24 ft. diameter, of 50,000 gallons capacity, supported on twelve wooden posts framed together. It was equipped with a wind engine of the Eclipse Wind Engine Co., of Beloit, Wis., a Fairbanks duplex pumping engine of 8,000 to 10,000 gallons capacity, and the Dodge stand-pipe for watering locomotives (Eng. News, March 19, 1892), which is a specialty of the Sheffield Car Co., of Three Rivers, Mich.

Coal Cutting Machines.

In the Mining Building there were numerous types of coal cutting machines. That of the Peoria Coal Drill Works, of Peoria, Ill., has cutters on the edges of two disks revolving in opposite directions, the disks being at the end of a bar supported by a frame on a four wheel car. S. Brown, of Pittsburg, Pa., had a coal cutter consisting of a horizontal endless chain fitted with cutters. The Sullivan Machine Co., of Chicago, Ill., showed the Mitchell mining machine for undercutting coal in long-wall mines, and the Smith machine for room and pillar mines. It also exhibited the Stanley heading machine for entry driving, having a revolving boring head and a traveling chain fitted with cutters. With a crew of three men it can drive an entry 6 ft. diameter at 25 ft. in ten hours, the same men loading the coal and laying the track The Jeffrey Mfg. Co., of Columbus, O., had air and electric coal cutters consisting of a frame carrying at its end a horizontal cutter bar fitted with cutting bits, the bar being revolved by a link steel chain. The electric motor occupies a space only 20×20 ins., and will develop 15 HP., running the cutter bar at 200 revolutions per minute. Air and electric coal drills were also shown. The Ingersoll-Sargeant Drill Co., of New York, had a coal cutter, and McCune & Co., of Sterling, Ill., showed the McNelly coal drill.

Wooden Flooring.

A patented design of wooden floor, in which the flooring is securely held to the concrete base, was exhibited by J. F. Ebner, of 101 Old St., London, England. In the concrete are embedded specially made corrugated iron channels, the channel being wider at the bottom than at the top, so as to form a dovetail or locking groove in the foundation. Undercut grooves are also formed in the floor boards. A layer of hard-setting bituminous composition is laid between the concrete and the floor, filling the grooves in each, and thus securely fastening the floor down even in case of shrinkage of the wood. The composition forms an effective damp course. This plan is extensively used for parquet and wood block floors in public and private buildings, residences, offices, railway stations, etc., and is in use in the Holland House Hotel, New York, N. Y.

Lubricating Bags.

A method of lubricating open necks of rolling mill rolls, engine bearings, etc., is by the use of

Phillips' lubricating bags, which are made of a strong, coarse and porous material, and of any required shape or size, according to the position they are to occupy. The material of close or open texture, according to the flow of lubricant required, and is filled and saturated with oil or grease. The exhibit showed these bags applied to the open necks or bearings of rolling mill rolls. They are largely used in England, and by the Illinois Steel Co., Oil Well Supply Co., etc., in this country, and over 4,000,000 are said to be now in service. The American office is at Mansfield Valley, Pa., in charge of H. Quinn, Manager, and Edward Lewis, Superintendent.

A NEW PNEUMATIC INTERLOCKING SYSTEM.

There has recently been installed at the crossing of the Delaware, Lackawanna & Western and the Western New York & Pennsylvania railways in the outskirts of Buffalo a pneumatic interlocking plant operating home and distant signals and derailing switches on both lines. The main peculiarity of this plant from the operating standpoint is that it dispenses entirely with electricity and with mechanical interlocking, and the whole work, including movement of semaphores, derailing switches, detector bars and interlocking the various parts of the mechanism, is done by compressed air. The use of liquid in the pipes to transmit the pressure, which has been a common feature of compressed air interlocking systems, is also done away with, and the plant as erected is very simple. Fig. 1 shows a plan of the tracks at the crossing, with the position of the home signals and the derailing switches. It will be seen that the double tracks of the Lackawanna cross a main track and siding of the Western New York & Pennsylvania. The latter road has yards on each side of the crossing, making frequent movement of trains over it necessary.

Fig. 2 is a plan of the pipe system by which the compressed air is conveyed to the switches and signals. Only short portions of the tracks are shown in order to avoid confusion. It may be well to preface explanation of this diagram by saying that the semaphores are pulled down to the safety position by admitting compressed air to a cylinder on the semaphore post, and are counterweighted to rise to a danger position when the air is released. The cylinders which move the derailing switches, however, are double-acting. The pipes leading from

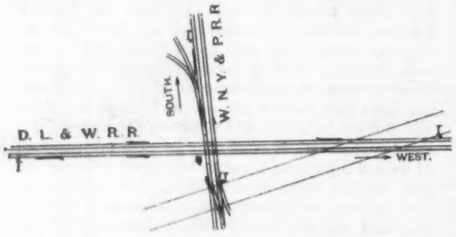


Fig. 1. Plan of Interlocked Crossing at Buffalo, N. Y.

each switch and signal to the signal tower are shown in Fig. 2, which also shows in diagram the valve in the signal tower by which the whole mechanism is operated. Fig. 3 is a view reproduced from a photograph of the operating lever in the signal tower, inclosed in its cabinet. This lever has three positions: (1) Vertical or mid position, in which the air is released from all of the pipes and all signals on both roads stand at danger; (2) inclined to the front, which admits air to the pipes controlling signals and switches on the Western New York & Pennsylvania, and (3) inclined to the rear, which releases the air in the W. N. Y. & P. pipes and admits air to the pipes controlling switches and signals on the Lackawanna tracks.

Referring again to Fig. 2, in the signal tower is a reservoir holding about 75 cu. ft. in which a pressure of about 10 lbs. per sq. in. is constantly maintained by an air compressor. If, now, the operator moves the lever in the tower to the left, the air in the reservoir is placed in communication with the pipe passing out to the left. The air rushes through this pipe to the cylinders controlling the derails on the D., L. & W. tracks and opens them. No air enters the signal pipes on this line, so the semaphores remain at danger. At the same time the air passes into the pipe which closes the derails on the W. N. Y. & P. main line, and after doing this it goes on to the home and distant signals on the north side and the home signal on the south side, and turns them to safety. It also crosses to close the derailing points on the W. N.

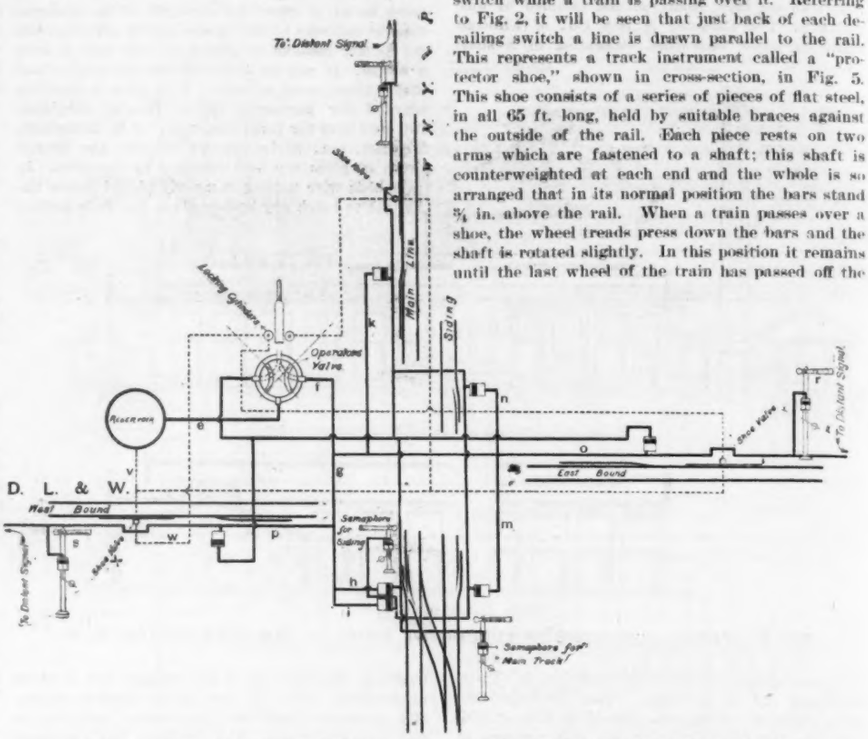


FIG. 2. PLAN OF PIPING, DERAILS AND SIGNALS FOR PNEUMATIC INTERLOCKING.

Y. & P. siding, both above and below the D., L. & W. tracks, and turns the semaphore governing the siding to safety. In a similar way the system of piping may be followed out on Fig. 2 by which the position of the signals and derails is reversed so as to stop trains on the W. N. Y. & P. and pass them on the Lackawanna.

We may next explain the mechanism by which it is insured that the signal shall not move to safety until the derailing switch is closed and locked. Fig. 4 is reproduced from a photograph of a derailing switch, showing the cylinder and locking gear. To close the switch, air enters the cylinder at the front end, forcing the piston to the right. The bar which moves the switch point has a notch in its upper surface. As the piston moves to the right the bar slides along beneath the weighted lever, seen in the cut, and when the stroke is completed the weighted lever falls into the notch, locking the point securely in place. The rear end of this weighted lever is connected to a cock in the air pipe, as seen; and when the lock drops into place the cock is opened and the air rushes onward to the signal. It will be seen from the above that air cannot pass to the signal until the derailing point is closed and locked. Thus any collection of ice or snow or other obstruction preventing the switch rail from coming home will prevent the lock from closing and the signal will remain at danger.

Suppose now the signal lever in the tower is reversed. This opens to the atmosphere the pipe leading to the front end of the cylinder and thence to the signal and the air rushes out. At the same time air is admitted to the right-hand end of the cylinder. It is obvious now that so long as the weighted lever rests in the slot in the switch bar, the switch will not open. To provide for the preliminary unlocking of this mechanism the crosshead on the end of the piston rod works in a slot in the end of the switch bar, so that the piston can move a short distance without moving the point. This preliminary motion is made use of to raise the weighted lever by shoving an inclined plane under it. The piston can then complete its stroke and open the point.

The only remaining portion of the plant requiring explanation is the device corresponding to the detector bar in mechanical interlocking, which prevents the signalman from moving a derailing switch while a train is passing over it. Referring to Fig. 2, it will be seen that just back of each derailing switch a line is drawn parallel to the rail. This represents a track instrument called a "protector shoe," shown in cross-section, in Fig. 5. This shoe consists of a series of pieces of flat steel, in all 65 ft. long, held by suitable braces against the outside of the rail. Each piece rests on two arms which are fastened to a shaft; this shaft is counterweighted at each end and the whole is so arranged that in its normal position the bars stand ¾ in. above the rail. When a train passes over a shoe, the wheel treads press down the bars and the shaft is rotated slightly. In this position it remains until the last wheel of the train has passed off the bar. Near the center of the shaft is a counterweighted arm, the weight of which when in its normal position rests on the stem of a three-way valve, holding the valve closed. When the weight is lifted by the rotation of the shaft, air from the reservoir (see Fig. 2) passes through the valve and a pipe to a small cylinder in the tower. This cylinder is so placed that when its piston is forced

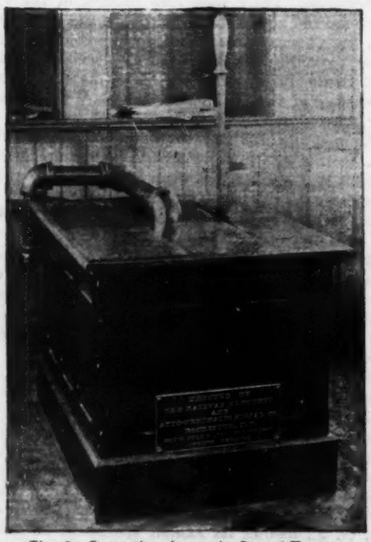


Fig. 3. Operating Lever in Signal Tower.

out it locks the operating lever in such a way that it cannot be moved to the position which would open the point. The lever can, however, be brought to its vertical position, so that the signals behind that train can be brought to danger; but it can-

not be placed in the position which would open the point or would set at safety the signals on the opposing track. When the shoe returns to its normal position the air in the locking cylinder is exhausted and the lever unlocked. It is stated that this shoe has all its parts so protected that snow or ice can have little effect on it; the whole weight of the train is brought into play to rotate the shaft, and a heavy counterweight is applied to bring it back to the normal position. About 9 ft.

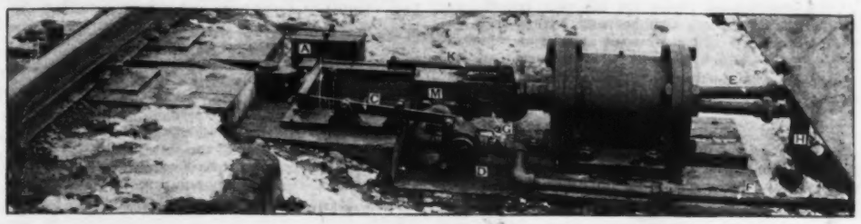


FIG. 4. DERAILING SWITCH AND OPERATING CYLINDER.

on each end of the bar is given an incline, so that there is no sudden shock when a train passes on or off.

An important feature in which this system differs from ordinary pneumatic installations is that the air is used at low pressure, only 10 lbs. per sq. in. One reason for adopting this is economy of air. The total volume of the pipes being alternately filled and emptied, the power used is directly proportioned to the air pressure. About 17 cu. ft. of free air is required for each change of signals. Another advantage of the low pressure is that the air is very little heated in compression and loses what heat it has while it is stored in the reservoir, which stands outdoors and is unprotected. As the air is at a low pressure in the pipes, its fall of temperature when released is not great, and there is therefore absolutely no deposit of moisture to cause stoppage of the pipe by freezing. The signalman in the tower also attends to the boiler and air compressor; the latter being controlled by an automatic valve requires but little attention.

The plant above described was designed and built for the railway companies interested by the Auto-Pneumatic Railway Signal Co., Rochester, N. Y. It was put in operation on Oct. 24, and has since been in constant use, the number of train movements over the crossing averaging about 400

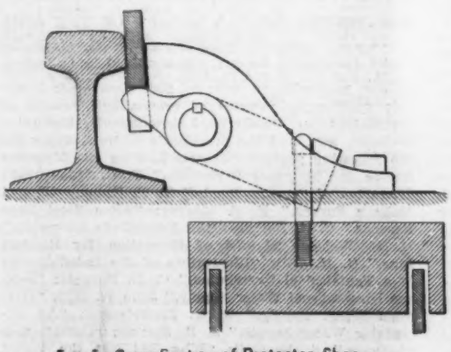


Fig. 5. Cross Section of Protector Shoe.

daily. We are informed that the railway officers report that since the plant was put into service not a single failure in operation has been recorded against it.

It will be seen that in the system above described when all the tracks of one road are blocked all the tracks of the other are clear. This does very well on a simple crossing like that just described; but on a crossing with a greater number of tracks, it might be desired to clear one track only, leaving the parallel ones of the same road blocked. We illustrate herewith (Fig. 6) the system devised by Mr. Dodgson, the Chief Engineer of the Signal Co., to meet this case, the patents on which are now owned by the company. Without taking space to explain this in detail, we may say that in general the same system of construction is followed as in the system just described. The principal addition is the use of a "sliding valve" (shown in section in Fig. 6), the office of which is to connect a pipe so that it will take air from any one of two or more pipes which are not connected to each other. The same device is used on the pipes leading to the locking cylinders. Any one interested in the subject will find little difficulty in studying out the working of the system from Fig. 6.

The officers of the Auto-Pneumatic Railway Signal Co. are: President, Dr. J. H. McCartney; Vice-President, Geo. Weldon; Secretary and Treasurer, T. A. Smyth; Chief Engineer, Frank L. Dodgson. Its headquarters are in the Ellwanger & Barry Building, Rochester, N. Y. The company is a newcomer in the signaling field, and its progress will be watched with much interest. It is probably true that many railway men are inclined to look with considerable favor on any attempt to perform interlocking without the use of electricity, and at the same time do away with the severe manual labor of the mechanically operated systems. Interlocking machinery is complicated and expensive at best, but it is rapidly becoming an absolute necessity; and whatever system can be made simplest and cheapest without transgressing the cardinal requirements of safety and reliability, is bound to receive a welcome from railway managers.

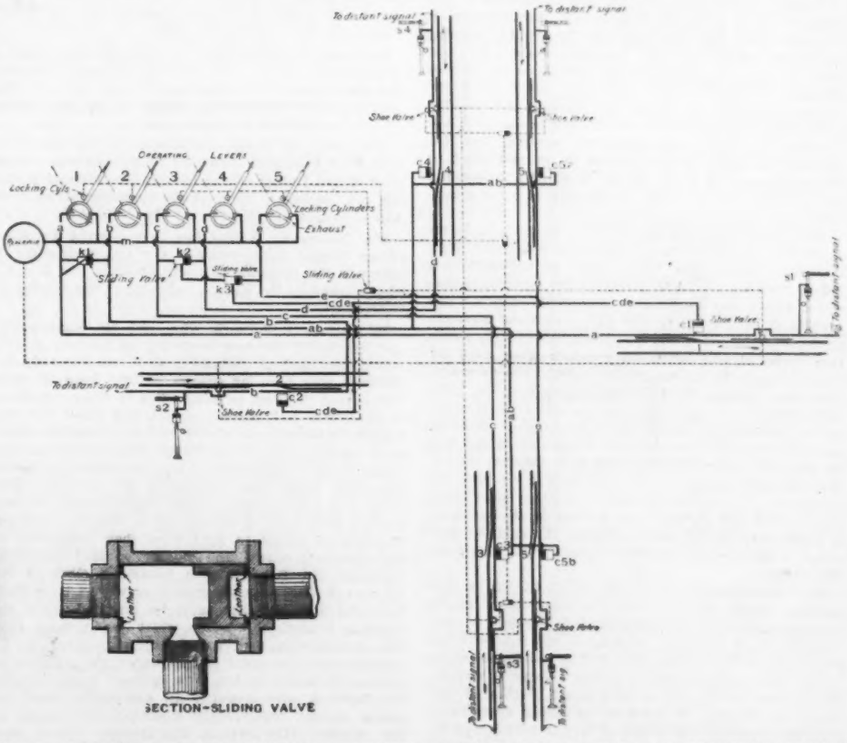


FIG. 6. PROPOSED ARRANGEMENT OF PNEUMATIC INTERLOCKING PLANT FOR EXTENDED SYSTEM OF TRACKS.

APPLICATION OF PHOTOGRAPHY TO SURVEYING.

The following is an abstract of the report of Mr. E. Deville, Surveyor-General, of the results obtained in Canada by the application of photography to surveying:

The map of the Rocky Mountains Park of Canada and surrounding country sent to the Chicago International Exhibition consists of 12 of the sheets of the Topographical Survey, which have been put together. Each of the sheets is 10 minutes in longitude by 7½ in latitude. The scale is 1-40,000 and the interval of contour lines 100 ft.

Until recently the land surveys of the Dominion government were confined to the prairies of Manitoba and the Northwest Territories; the operations were simple, and consisted merely in defining the boundaries of townships and sections. These lines form a network over the land, by means of which the topographical features, always scarce in the prairies, are sufficiently well determined for general purposes.

When the surveys were extended to the Rocky Mountains, the conditions were found to be entirely different and the methods hitherto employed inadequate. The topographical features are well marked; the survey of the section lines is always difficult, often impossible, and in most cases useless. Still, the proper administration of the country required a tolerably accurate map, and means had to be found to execute it rapidly at a moderate cost.

The ordinary methods of topographical surveying were too slow and expensive for the purpose; rapid surveys, based on a triangulation and on sketches, were tried, and proved ineffectual; then photography was resorted to. The results have been highly satisfactory.

The method is based on the fact that a photograph taken with a suitable lens is a true perspective, in which the focal length is the distance line. By drawing the horizon and principal lines all the measurements which are usually taken on the ground may be obtained from the photograph. There is, however, this difference, that while with the ordinary surveying instruments the topographer is restricted to a few constructions, photography affords a great variety of processes by the application of the inverse laws of perspective.

The first application of mathematical perspectives to surveying is due to Colonel Laussedat, of the French army; in 1850 he conducted a series of experiments before a commission appointed by the War Office.

His perspectives were obtained by the camera lucida. A year or two afterward he substituted photography for the camera lucida; this, of course, did not cause any change in the method, which remains the same, no matter how the perspectives are obtained, and which he described in 1854 in the "Memorial de l'Officier du Genie," No. 16.

It is not proposed to describe here the details of the process or the instruments employed*; to do so would go far beyond the limits of this paper. The object is simply to give a short review of the work accomplished and of its results.

Regular photographic surveys were commenced in 1888 in the main range of the Rocky Mountains, near the Canadian Pacific Ry.; they have since been continued without interruption, and now cover about 2,000 square miles.

These surveys were all executed by Mr. J. J. McArthur, with a party consisting of one assistant, a packer and a laborer. The area covered each year has increased from 250 square miles in 1888 to about 500 square miles in 1891 and 1892. Want of experience at the beginning accounts for the smaller figures of the first years, but a limit has now been reached which it is not possible to exceed in that part of the Rocky Mountains. Five hundred square miles is the extent of ground which a party, traveling rapidly, can see during one season; as photography, no more than any other process, will permit what has not been seen to be mapped, this must be the limit for that section of the territories. It will of course vary with the nature of the ground, being greater in an open district with large undulations, while it will be smaller in a very broken country like the Selkirk range, in British Columbia. The topographer does not need more than a few minutes at each station to observe angles and expose his plates; the time thus employed during a whole season is trifling, and practically he is always traveling, except during bad weather. After the short summer is over the packer and laborer are discharged, and the topographer and his assistant employ the balance of the year in plotting their surveys.

A synopsis of the results for any one year will, better than anything else, permit the advantages of the method to be realized. Taking 1892, for instance, it is found that Mr. McArthur left Morley, his starting point, on the 29th of June. Before that date the snow was too deep for work. He had to stop on the 17th of October, at which time winter had set in, and the snow was again too deep for traveling. Of the 111 days intervening, 48 were lost through smoke, rain and snowstorms, leaving only 63 actual working days. Assuming the work of that season to be equivalent to about 500 square miles, which is slightly below the actual figure, it represents an average of eight square miles per working day.

The plot is made on a scale of 1-20,000, and is reduced for publication to 1-40,000. Some remarks in an American publication about one of the published sheets (anthracite) led to a special examination of that sheet, which may be given by way of illustration. The area is 63 square miles. The plot was made from six stations inside and eleven stations outside of the sheet. One thousand and seventy-five points were fixed by intersection or by constructions equivalent in accuracy. They were taken from 35 photographic views. This corresponds to 17 points per square mile. There would be no difficulty in fixing more points and obtaining greater accuracy; the only limit is the time which can be devoted to the plotting. The rule adopted here is that the topographer and his assistant must plot the surveys of the preceding season before they start again for the field. If at any time a more detailed plan of a particular locality were required, it could be prepared from the same views without going back on the ground.

The expenditure in 1892 was $1,470.19. If to this amount we add the salary of the topographer, $1,500 per annum, and of his assistant, $730, we find a total expenditure of $3,709.19, which, at 500 square miles for the year, brings the cost to $7.42 per square mile.

This extremely low figure is due to several causes. In the first place, only a very small portion of the topographer's time is spent in surveying operations; practically, nearly the whole of it can be devoted to traveling for seeing the country, and he can map all he can see. His work consists of two distinct parts; on the ground he simply collects data, and with the exception of a few angles does not waste any of his time in making measurements. These are left for the winter months, to be attended to in the office, when the only expense is the topographer's and assistant's salaries. In the next place, the party, consisting only of an assistant and two men, is much smaller than required for ordinary surveys; its cost in 1892 was less than $1,500. The plotting is also more quickly performed, owing to the numerous processes based on the laws of perspective which are at the disposal of the topographer.

But it must not be understood that every photographic survey must prove a success or that a failure after a first trial indicates that the method is defective. The fact is that it requires not only experience, but also a combination of those faculties which make an accomplished topographer. Unlike other methods, he has nothing before his eyes to show the progress of the work on the gaps that may exist in it. His undeveloped plates are his only records; so every time he exposes one, he must have present in his mind what it will give, what amount of information he will extract from it, what constructions he will apply, what further views are necessary and how they will combine together. These acquirements are not the lot of every surveyor, and unless the man is well qualified, his attempts at photographic surveying will not be successful. For this the method is not to blame; if properly used, it will give results far beyond what could be accomplished by any other process.

* The method and instruments of the Canadian surveys are described in "Photographic Surveying, Including the Elements of Descriptive Geometry and Perspective. By E. Deville, 1889." The book is now out of print.

PERSONALS.

Mr. Charles A. Scott, at one time General Manager of the government railways in Nova Scotia, died at Quebec, Dec. 15.

Mr. H. Rittenhouse has been appointed Assistant Engineer of the Norfolk Division of the Norfolk & Western R. R., with headquarters at Crewe, Va.

Mr. Charles H. Bihler, formerly Division Engineer of the Northern Pacific R. R., has been appointed Principal Assistant Engineer, vice Mr. E. H. McHenry, appointed Chief Engineer.

Mr. George K. Lowell has been appointed General Superintendent of the Louisville, New Albany & Chicago R. R., vice Mr. S. J. Collins, who has accepted a similar position on the Wisconsin Central.

Mr. Henry Schlacks has been appointed Superintendent of Motive Power of the Denver & Rio Grande R. R. He resigned a similar position on the Illinois Central R. R., in February, 1893.

Mr. Ransom C. Scowden, of Louisville, Ky., died at Poughkeepsie, N. Y., Dec. 12, aged 50 years. He was for many years City Engineer of Louisville. He was also the Chief Engineer in charge of the construction of the Louisville & Portland Canal.

Mr. Frank H. Dabney, of Louisiana, has been nominated by President Cleveland to be Consulting Engineer of the United States on the international boundary commission, to regulate the boundary between the United States and Mexico, of March 1, 1889.

Mr. Walter H. Wickes has been elected President of the Wickes Refrigerator & Car Co., which has its offices in the Monadnock Block, Chicago. He is a son of the late Jas. H. Wickes, patentee of the Wickes refrigerator car.

Mr. George H. Babcock, who, with Mr. Stephen Wilcox, perfected the now well known Babcock & Wilcox boiler, died at Plainfield, N. J., on Dec. 16. Mr. Babcock was born at Otsego, N. Y., June 17, 1832. He started the first printing office in Westerly, R. I., in his youth, took daguerreotypes, and while still very young, he became associated with Mr. Charles Potter, now the proprietor of the Potter Press Works in New York, in the manufacture of a polychromatic job printing press, which was invented by Mr. Babcock. This press won a silver medal at the Crystal Palace World's Fair of 1855, but the success of the Gordon press and the lack of money to fight what they considered an infringement, caused the closing of that particular business. Mr. Babcock then became a clerk to Mr. Thomas D. Stetson, a patent lawyer with a large practice, and while in that office he invented, with Mr. Stephen Wilcox, the boiler which made them rich. Mr. Potter was first associated with them in its manufacture, but later retired under the pressure of growing business in his own cylinder press factory. Mr. Babcock also invented an automatic cut-off for steam engines which entirely evaded the patents of Mr. Corliss. His partner, Mr. Stephen Wilcox, died at his residence in Brooklyn only a fortnight ago, on Nov. 27.

NEW PUBLICATIONS.

NEW JERSEY GEOLOGICAL SURVEY.—Annual Report of the State Geologist, Mr. John C. Smock, for 1892. 8vo; pp. 367; folding maps and illustrations.

This last report of the State Geologist of New York adds one more volume to a series of reports which for thoroughness and general excellence has no peer among the official returns of like character from other states. The main geological parts are full reports of progress as a rule; but several new features have been added. Among these especially to be noted is a series of notes upon the sea dikes of the Netherlands and the reclamation of the lowlands of the same country, prepared with special reference to the treatment of the 300,000 acres of tide marsh area in the State of New Jersey. The differences in useful character of the soils of the Dutch and the Jersey swamps is pointed out together with the comparative climatic conditions affecting reclamation. As to area, the tidal swamps of the Hackensack and Newark rivers, Staten Island and Raritan River and Bay cover an area of 30,439 acres. These tidal lands are made up of clay, clay and peat mixed, and peaty bottoms. The first are best adapted to agriculture and easiest reclaimed; the latter are exceedingly difficult to drain below tide level. The heavier rainfall of this section of the United States would require the provision of larger pumping plant than the annual precipitation of 27.4 ins. in the Netherlands.

In this report Mr. C. C. Vermeule continues his interesting and valuable investigation into the water supply and water power of the state. With the report is a map defining the location and extent of the watersheds in the northeastern part of New Jersey, showing those now in use and those available for additional supply. This map is supplementary to the map published in 1890 showing all the watersheds in the state. The report gives the elevation of the outlet above tide, the daily capacity in gallons and notes whether or not the supply is utilized. The full report upon this subject was in preparation at the time of the issue of the report, and it is probably in press now. A full list of the publications of the state survey is appended with those out of print noted. These publications are distributed without further expense than that of transportation; but for the unusually complete and handsome set of maps in the Atlas the uniform rate of 25 cts. each is charged. Sets of these twenty maps, each 18½ × 27 ins., mounted on muslin and bound in half-morocco, can be had for $13.50 per copy from Mr. I. S. Upson, New Brunswick, N. J.

NATIONAL CONSOLIDATION OF THE RAILWAYS OF THE UNITED STATES. By Geo. H. Lewis, M. A. New York: Dodd, Mead & Co. 12mo; cloth; pp. 326.

This is perhaps the most temperate and convincing argument for the consolidation of the railways of the United States under governmental control which has appeared in recent years, and deserves careful reading by all interested in the ever prominent "railway problem." Coming from an Iowa man from whom we naturally expect more or less rabid views on the subject of governmental control, this is quite refreshing. With much of what the author says we can heartily agree, but that his somewhat ponderous machinery of combined government and private management would operate successfully we much doubt. A personal equation enters into all schemes of this kind which is not sufficiently allowed for. The author realizes this more clearly than most writers have done, and frankly acknowledges his inability to provide for certain points in the problem. We can recommend the book to those who may wish a generally fair and liberal argument in favor of the government consolidation of railways.

FOURTEENTH ANNUAL REPORT OF THE OHIO SOCIETY OF SURVEYORS AND CIVIL ENGINEERS: Being the Transactions of the Society at its Fourteenth Annual Meeting, held in Columbus, O., Jan. 17, 18 and 19, 1893. Secretary, C. A. Judson, Sandusky, O. 8vo; pp. 236; illustrated; 50 cts.

In addition to minutes of proceedings, reports of committees on blanks and instruments, highways, drainage, etc., and the president's address, there are the following papers: "Observations on the Magnetic Needle and Magnetic Variations," T. C. Mendenhall; "Location of Country Roads," T. F. Brown; "How I Make a Survey," E. E. Harvey; "Some Steel Tape Records," C. H. Burgess; "An Example in Surveying," H. L. Weber; "Method of Correction for Random Line," G. H. Hill; "Illustration of the Indefiniteness of a Tautological Description," C. H. Burgess; "Sewage Disposal and Water Supply," John W. Hill; "Dayton's Water Supply," G. R. Stattelmann; "An Acceptable Water Supply," J. B. Strawn; "Construction of Dams," S. Bachtell; "Why Did Not the Water Freeze in the Pipe?" J. B. Strawn; "Portland Cement," F. W. Brown; "Pike Roads of Galion and Vicinity," J. B. Weddell; "The System of Laying Out, Constructing and Maintaining Road Improvements in One of the River Counties of Ohio," J. M. Harper; "Foundations for Improved Streets, Especially in Cities," G. S. Innis; "Suggestions on Road Legislation," E. B. Opdyke; "Brick Pavements," L. E. Chapin; "Panorama of Bucyrus," H. L. Weber; "Marion Sewers," J. W. Scott.

TRADE PUBLICATIONS.

RAPID LATHE WORK, NEW METHOD.—Jones & Lamson Machine Co., Springfield, Vt.; 8vo pamph., oblong; pp. 71; illustrated.

This is an illustrated catalogue describing the construction and operation of the flat turret lathe built by this company, and incidentally briefly describing the evolution of the turret lathe from its first form to the well known tool of the present. The artistic

embossed cover of the catalogue deserves especial mention.

UNIVERSAL CUTTER & TOOL GRINDER.—The Cincinnati Milling Machine Co., Cincinnati, O.; 8vo; pamph., illustrated; pp. 24.

This is a very complete illustrated description of the company's universal tool and cutter grinder, showing its application to various forms of cutters and spindles, and giving some suggestions as to the best methods of conducting this class of work.

CRANES.—Industrial Works, Bay City, Mich. 8vo; pp. 43; plates 13.

This pamphlet describes and illustrates the various types of locomotive, jib, transfer and traveling cranes made by this company, among which may be specially noted the locomotive or wrecking cranes of 7 and 12 ton capacity used at the World's Columbian Exposition, and which we shall describe shortly.

COAL MINING MACHINES.—Jeffrey Mfg. Co., Columbus, O. 8vo; pp. 96; illustrated.

Coal cutting by machinery is quite extensively practiced, and this pamphlet shows different patterns of machines operated by compressed air and electricity. Essentially they consist of horizontal bars fitted with cutters and revolved by means of link chains. There are also descriptions of other machinery, including hand, electric and air drills, electric locomotives and pumps, ventilating fans, coal and ore car dumps, bucket conveyors for coal tipples, etc.

ELEVATOR AND HOISTING ENGINE.—James Boyd, St. Paul, Minn. 12mo; pp. 24.

This is an illustrated catalogue of vertical elevators for materials in construction work, using wire rope or gaspipe guides, and hoisting engines for operating the elevators.

CHAIN BELTING.—Jeffrey Mfg. Co., Columbus, O. 8vo; pp. 266; illustrated.

This is an illustrated catalogue and price list of various patterns of chain conveyors and elevators for coaling stations, factories, warehouses, etc. The chains are made with and without rollers, and some of them have detachable links. In addition to this class of work the company also supplies sprocket wheels, clutches, pulleys, rope transmission plant, coal-cutting machines, electric drills and mining locomotives, and general contractors' and miners' supplies.

CHANNELING MACHINES.—Steam Stone Cutter Co., Rutland, Vt. 4to; pp. 16; illustrated.

This pamphlet is devoted to the Wardwell stone channeling and quarrying machine, with testimonials and particulars of its work.

SPRINKLING WAGONS.—Miller-Knoblock Wagon Co., South Bend, Ind. Two pamphlets; 8vo; 20 and 48 pp.

These pamphlets describe and illustrate various forms of sprinkling wagons for streets, parks, etc., some of which were described in our issue of Nov. 30.

SOCIETY PROCEEDINGS.

WESTERN RAILWAY CLUB.—At the regular monthly meeting on Dec. 19 the subject discussed was the paper on "Locomotive Draft Appliances at the World's Fair," read at the November meeting by Mr. W. C. Squire. A paper on "Steel in Car Construction" was presented by Mr. J. D. McIlwain, Superintendent of the Harvey Steel Car Works.

ENGINEERS' CLUB OF CINCINNATI.—At the November meeting a paper was read by Mr. C. N. Miller on the "Construction of the Norwood Reservoir," which is essentially a cylinder of steel plates, 4 ft. diameter and 60 ft. high, with a conical roof, resting on a concrete foundation and situated on a hill about 2,000 ft. from the site of the deep wells from which the water supply is derived. J. F. Wilson, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The 41st annual meeting will be held in New York, beginning Wednesday, Jan. 17, 1894, at 10 o'clock. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, reports of special committees presented, and other business transacted. Thursday will be devoted to excursions. Arrangements for these and for the evenings of both Wednesday and Thursday, are in the hands of a committee, and will be announced at a later date

F. Collingwood, Secy.

ROADMASTERS' ASSOCIATION OF AMERICA.—The following are the subjects to be reported on at the next convention, which will be held in New York City, in September, 1894; after each subject is given the name of the chairman of the committee appointed to report upon it.

Records and Reports of Maintenance of Way Department, Chas. S. Churchill (Norfolk & Western); Track Joints, R. Caffrey (Lehigh Valley); Track Tools, G. W. Merrill (C., M. & St. P.); Inspection and Distribution of Ties, Garrett Davis (B., C. R. & N.); Arrangements for 12th Annual Convention, Robert Black (Manhattan Elevated).

W. W. Sharpe,
Sec. and Treas., Way Cross, Ga.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The 66th meeting (being the 24th annual meeting) will be held at the Princess Anne Hotel, Virginia Beach, near Norfolk, Va., beginning Tuesday, Feb. 20, 1894. In connection with this meeting, excursions to Norfolk, Portsmouth navy yard, Newport News and Hampton, and a trip into the Dismal Swamp are contemplated. Continued discussion of the papers presented at the Chicago meeting of August last will be a special order at this meeting. While contributions concerning any of these papers will be welcome, the following topics are particularly suggested, as possessing much interest for mining engineers and metallurgists: "The Physics of Steel" and "The Genesis of Ore Deposits." The Chicago meeting was reported in our issues of Aug. 3 and 10, 1893.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The quarterly meeting of the association was held at the Parker House, Boston, on Dec. 13. A lunch was served at 1 o'clock, after which the subject of covered reservoirs was taken up. Mr. F. F. Forbes, superintendent of the water-works of Brookline, Mass., read a paper describing the covered reservoir recently built in connection with his works. Mr. Geo. E. Winslow, Superintendent of the water-works of Waltham, Mass., briefly outlined the history of the works there, including the causes which led up to the recent sinking of a well in the infiltration basin and the covering of the basin and well with a roof. A short paper descriptive of this roof was next read by Mr. Frank P. Johnson, City Engineer of Waltham. The discussion on covered reservoirs took up so much time that the consideration of earthen embankments was postponed.

As the subject of covered reservoirs is closely related to the quality of water supplies and one of the structures described at the meeting covers an infiltration basin and well, the illustrations and descriptions of these structures given on another page of this issue are included under our series of articles on "Water Purification in America."

In the discussion of these papers, Mr. F. L. Fuller, M. Am. Soc. C. E., stated that a covered reservoir is now being built for the water-works of Methuen, Mass., with a capacity of 1,000,000 gallons. It involves about 6,000 cu. yds. of excavation and will cost less than $16,000. It is similar to the covered reservoir at Franklin, N. H. (see Eng. News, May 12, 1892, for illustrated description), and, like it, was built under Mr. Fuller's direction.

Mr. A. F. Noyes, M. Am. Soc. C. E., called attention to the extreme types of construction, light and heavy, shown by various covered reservoirs.

Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., made inquiry regarding the effect upon the bottom of the reservoirs, when empty, caused by the head of the ground water surrounding the reservoirs. No harmful results were related by any of the members except Mr. Freeman C. Coffin, who stated that upon suddenly emptying a reservoir at Cohassett, Mass., the concrete bottom bulged up. The engineer cut a hole through this bottom, from which water gushed up.

Some further discussion, relating to the Brookline reservoir and the Waltham basin and well, is included elsewhere in this issue in the article mentioned above.

It was announced that the three winter meetings of the association will be at Young's Hotel, where most of the winter meetings have been held for a long time past.

NEW ENGLAND RAILROAD CLUB.—At the meeting on Dec. 13 the subject discussed was "Locomotive Boilers and Their Attachments." Mr. O. Stewart, Fitchburg, said that the fewest number of holes possible should be made in the boiler. He did not believe in inside check valves for closing automatically openings in boilers, in case of breakage of the attachment. His practice is to supply steam for both injectors, air-pump, blower and steam gage from one ⅝-in. opening. He advocated the use of narrower water spaces around the firebox and the provision of some form of water circulator to take water from near the front end and deliver it near the mud ring. Mr. Smith, of the Boston Forge Co., said that he had tried various widths of water space with vertical tubular boilers, and had found in general that the wider the water space the better the boiler steamed. He began 28 years ago with 2.5 ins. water space and increased it to 3 ins. and 3.5 ins. and finally to 5 ins. The last boiler has given by much the best satisfaction in every way.

Mr. J. N. Lauder favored a wide water space, better 4 ins. than 3. He had little faith in water circulating devices and thought with wide water spaces they were not needed. Besides giving better steaming qualities a wider water space gives a longer staybolt which is less liable to break. He practices drawing in the top of his furnace, giving longer staybolts near the top, and finds that staybolt breakages are greatly decreased. In the last ten years 75 locomotive boilers have been built under Mr. Lauder's supervision, and in that 75 there have been just seven broken staybolts. These boilers have been in service from two to eight years. The first boiler built to carry 175 to 180 lbs. pressure has run up to this time with only three broken staybolts. On the other hand, he had recently seen boilers from locomotive builders in which every staybolt had to be replaced in less than three months. The staybolts were not broken, but they were too small and did not fill the holes. They were put in that way to save time, and after a few weeks they began to leak. A staybolt should have a good thread on it, the hole should have a good thread and the bolt should fill the hole. The less heading over and pounding done on the end of the staybolt the better. A great many staybolts of good material are made brittle by the extra pounding they receive in heading them down. He uses staybolt iron costing 6¼ cts. per lb. The extra cost is fully compensated for in the saving in repairs.

The testing of staybolts to find broken ones is an uncertain operation. In a boiler which recently exploded, in which were found 19 broken staybolts, the bolts were found and replaced, the other 19 being missed.

A certain leading road, not many months ago, had all the men who have the testing of staybolts at different points of the system brought to headquarters. A boiler with a large number of broken staybolts scattered all over the furnace was given to them to test. Each of the men was required to go in and chalk the broken staybolts, the marks being rubbed out after each had finished. They used the hammer test, and the result was that some had found a good deal more than others, and no one had found them all: some found nearly all broken; some found nearly all sound. The discussion was continued by Messrs. Twombley, Butler, Fuller and Robinson. At the January meeting a paper on "Railroad Building with Reference to Economy of Operation" will be presented by Prof. C. Frank Allen, of the Massachusetts Institute of Technology. The meeting will be held on Jan. 10 at Wesleyan Hall, 36 Bromfield St. Hereafter the proceedings of the club are to be printed in full in pamphlet form. They can be obtained by addressing the secretary, Mr. F. M. Curtis, Old Colony R. R., Boston, Mass.

COMING TECHNICAL MEETINGS.

DENVER SOCIETY OF CIVIL ENGINEERS.
Dec. 26. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 1. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Jan. 2. Secy., W. Halliburton.
INDIANA ENGINEERING SOCIETY.
Jan. 2, 3 4. Annual meeting at Indianapolis. Secy., W. P. Carmichael, Williamsport, Ind.
MICHIGAN ENGINEERING SOCIETY.
Jan. 2, 3, 4. Annual meeting at Jackson. Secy., F. Hodgman, Climax, Mich.
WESTERN SOCIETY OF ENGINEERS.
Jan. 3. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 3. Annual meeting Jan. 17, 18. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 3. Secy., Arthur Thacher, Odd Fellows' Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 4. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF MINNEAPOLIS.
Jan. 4. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Jan. 5. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Jan. 5. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 6. Secy., L. P. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Jan. 6. Secy., P. Valentine, At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 8. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 8. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 9. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Jan. 9. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Jan. 9. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Jan. 10. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Jan. 10. Secy, F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 11. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 11. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Jan. 12. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 13. Secy., G. O. Foss, Helena.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 16. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 16. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Jan. 16. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Jan. 17. Secy., L. J. Carmalt, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 17. Secy., S. E. Tinkham, 36 Broomfield St.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 18 Secy., J. F. Wilson, 24 W. 4th St.
NEW YORK RAILROAD CLUB.
Jan. 18. Annual meeting. Secy., John A. Hill, Temple Court.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Jan. 18. Secy., Allen Strale, 100 Washington St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 18. Secy., S. A. Charriot, Macon, Ga.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
Jan. 19. 201 Washington Building.
CENTRAL RAILWAY CLUB.
Jan. 24. Secy., H. W. Spear, Buffalo, N. Y.

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AND

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

As doubtless more than one reader observed, there was a blunder in the make-up of the note appended to Mr. Collingwood's letter in our last issue. The first paragraph was written as a substitute for an earlier note; but, by a misunderstanding in the printing office, both appeared in type. Fortunately, or unfortunately, there was no such conflict between the two notes as to make the error apparent.

Judging from the flood of circulars and correspondence on the subject of this election which have reached us, considerable interest is taken in its result. Therefore, in the interest of fair play and a fair election, we throw out this suggestion to all voters. The ballots are now out, 30 days before the election, as the constitution requires. Vote, if you intend to vote at all, on the strength of your own convictions or inquiries and without unreasonable delay. If you do not vote thus, do not vote at all, and especially do not send in a ballot sent to you on the eve of the election by some superserviceable acquaintance with a request to vote it. If you do so, though it is your legal right, yet you are in effect conniving at an unfair election. For in any such society only about one-third of the voters ordinarily vote. The rest are indifferent or uninformed. Their names are known. It is therefore in the power of a few partisans of either side, by waiting, say, three weeks, until all have sent in their ballots who have any opinion of their own to express, to parcel out the names of the indifferents among themselves, and to suddenly flood the mails with a lot of personal ex parte requests to these indifferents to vote a certain ticket inclosed. Most of them will do so, and thus the dozen or so men who manipulate the indifferents really decide the election! They could, if they chose, carry it either way by this device in almost every case, right over the heads of the real voters, who are likely to be somewhat divided. The device here pointed out is, of course, as immoral in essence as it is sharp and legal in form. The present Am. Soc. C. E. constitution contains one check against its use by one side only, which did not formerly exist, that the voting list is open to the inspection of any member, but even when used by both sides alike every vote thus obtained is really unfair, and in equity should not be counted at all, if it were possible to distinguish it from votes cast from personal conviction.

The annual report of the Commissioner of Patents has now grown to be an enormous volume of 776 pages, though confined chiefly to two great tables in which each patent issued during the year occupies only one line. The total number of patents issued in 1892 (excluding reissues and designs) was 22,661, being a few more than in 1891, but sensibly less than in 1889 and 1890. The number of patents applied for has also been nearly stationary for the past four years, averaging about 40,753, the number last year. It appears therefore that only about 58% of the patents applied for are granted. The number of reissues has steadily declined and is now insignificant. The number of patents granted yearly is now about five-fold what it was in 1860, and about twice what it was in 1867. Never until 1838 (and only once before 1846) were so many as 500 patents issued in one year; never until 1853 so many as 1,000; never until 1867 so many as 10,000, and never until 1883 so many as 20,000. After once attaining each of these rates (except the first, as stated) the number issued has never fallen below it. The ratio of growth is quite startling to look at, though there seems to be at last some check to it, since for ten years the number has been nearly constant.

As usual, the simplest things, which one would suppose had been patented in every form long ago, such as buttons, churns, fences, hinges, horseshoes, nut locks, plows, sashfasts, thill couplings and the like, appear in enormous numbers of 30 to 200 each. As usual "car couplings" leads the list with over four solid pages of new patents, nearly 400 in all, which is about 20% more than last year, and probably the largest number ever issued. The attention attracted to the subject by the practical settlement of the abstract issue of the best form, and the discussion due to its practical application on a large scale, seem to stimulate inventors who otherwise would never think of it to try and reopen the whole question anew. Of course a portion of these patents are rational ones by experienced makers and designers, but the great bulk of them are absolutely worthless upon their face, and a transparent waste of money which is encouraged by patent attorneys only for their fees. The claims are doubtless in most cases merely nominal, on the narrowest sort of special combinations; and yet we cannot but feel that if even these claims were properly examined in the Patent Office, few of them indeed would pass to issue over the 10,000 to 20,000 prior claims for all sorts of combinations. Doubtless a species of despair and mental nausea has struck the examiners and they let most anything go through to save the immense labor of proving that each successive piece of folly is not new.

The commissioner makes 14 important recommendations for new legislation, the most important of which have been made before, and all of which seem desirable, and one at least imperative unless gross frauds upon the office are to continue by interferences and other procedures whose only real purpose is to postpone the issue of the patent, and thus prolong its life, of which the telephone patents have afforded a number of aggravated instances. This is an amendment limiting the life of a patent to 20 years after filing of the application, thus making all delay in the office exceeding three years at the expense of the life of the patent. The fact that in every other country but our own (with possible unimportant exceptions) the patent dates from the filing of the application is alone sufficient to show that three years' delay for preliminary procedures in our office is amply sufficient, though there are good reasons for our exceptional practice which are not generally understood. To secure a patent in most foreign countries it must not have been previously patented or made public in other countries, a provision which we now do not imitate, but which the commissioner very reasonably recommends that we should except when it is waived reciprocally. The consequence of this provision is that an American must have an interval of time after he has secured a patent at home before it goes to public issue, or he loses important foreign patents. Our examination is also far more stringent than in other countries, with the possible exception of Germany in its recent practice, and when there is an even chance that a man may be refused a patent when he asks for it it is obviously fair that the life of his patent should not begin to run until he is sure he is to have one.

The Chicago River, says Capt. W. L. Marshall, of the U. S. Engineers, in his last report, leads all harbors of the United States in the number of arrivals and departures of vessels; is second only to New York in tonnage; but in capacity, depth and width of navigation it is but a third-class port. While improvements are now in progress along the chain of Great Lakes contemplating 20 to 21 ft. navigation at low water, the Chicago River has only 16 ft. at its mouth and is obstructed by numerous bridges and by three tunnels with from 16 to 18 ft. over their crowns. The river has been contracted in places by private wharves and filling to half its original width; bends in the river, rigidly fixed by docks, are so sharp as to prohibit the passage of the larger modern vessels, and the frequent bridges make navigation so difficult that prominent vesselowners say that the expense of moving a vessel to the elevators above Twenty-second St. and back to the lake again represents half the cost of grain transportation from Chicago to Buffalo. Captain Marshall briefly notes the projects now under way for the drainage of this river south toward the Illinois River; but he says that the execution of present plans means also the complete remodeling of the Chicago River in both its branches and the creation of large artificial channels to carry the sewage of the lowlying city of Chicago. Captain Marshall concludes by recommending that before any further appropriations are made for the improvement of the Chicago River the question of the future use of this stream should be definitely settled. This question is, whether it is to continue as now, simply a long line of private slips, docks or wharves utilized mainly for private or corporate gain and for the main sewer of a great city, or whether it is to constitute a connecting link under federal control between the Lakes and the Mississippi River. The further recommendation is made that no improvement in the river should be made at all by the general government so long as the city of Chicago uses this river as a dumping ground for its filth and refuse of all kinds.

This is rather serious reading for both the shippers of Chicago and the taxpayers of that city. What the present evidently inadequate harbor accommodations mean, in time lost and additional expense, can be estimated from the fact that in 1892 the total of arrivals and clearances at this port were 18,925 vessels with a tonnage of 9,770,457 tons. The 27 elevators of Chicago, all on this river or its branches, shipped in the same year 44,208,000 bushels of corn, 32,893,543 bushels of wheat and 19,692,500 bushels of oats, besides barley, rye and flour in lesser quantity. The other horn of the dilemma presented by Captain Marshall is the removal of the Chicago River from the drainage system, with the practically necessary construction of an intercepting system covering 22 miles of lake front and extending some miles inland. That the complete remodeling of harbor facilities, at some time in the near future, is absolutely necessary no one will deny who has taken the trouble to investigate existing obstructions. As to the drainage of this lowlying city, the promoters of the drainage canal now under construction believe that a flow of 600,000 cu. ft. of water per minute from the lake through this completed channel will remove the refuse of the city and so dilute it that it will be unobjectionable to the people of central Illinois or the Mississippi River towns below the mouth of the Illinois River. Lake disposal of this refuse is practically impossible without interfering with the water supply; and if by reason of continued phenomenal growth and increase of filth to be disposed of, there should ever be valid legal reasons against a discharge south-

ward, the further solution of the drainage problem would be an awkward one, and a solution involving untold cost and possibly land treatment.

THE RECORDS OF RENSSELAER GRADUATES.

The Rensselaer Polytechnic Institute is the oldest of American engineering schools, having sent out its first graduates in 1826, and having been a very successful school ever since. It has a record in which it may, and evidently does, take just pride. No school has been more successful in turning out men who have actually succeeded in their profession, at least no school among those of sufficient age to have the records of their graduates fairly indicative of tendencies; and most of the older schools cut a poor figure indeed in comparison with it.

For these reasons a pamphlet which the Institute has put forth, entitled "A Partial Record of the Work of Graduates" has an unique interest, not only as shedding light on the quality of the school, which is probably its main purpose, but as indicating certain tendencies in the profession. To the "general reader" its interest is chiefly from the latter point of view, and in that respect only we propose to examine it. It shows some curious and interesting facts, illustrating certain tendencies which we have often noted in the abstract, but which we have never before had so good an opportunity to show in the concrete.

The pamphlet is chiefly devoted to four lists of names, being lists of those among the graduates who are known to have attained any one of the following positions:

1. "Presidents of corporations"; 34 in all.

2. "Chief engineers of railways, bridges or bridge companies, steel works, iron works, coal companies, water-works, canals, etc."; 69 in all.

3. "Vice-presidents, general managers and superintendents of" railways, etc., as above; 121 in all.

4. "Professors and assistant professors of higher institutions of learning" (excluding inferior grades of instructors); 56 in all.

The name, title and year of graduation of each man included in either of these tables are given, and the facts are embodied in an interesting diagram which we do not reproduce, but from which we have made the following tabular abstracts. It is obvious that lists like this for an aggregate of 986 graduates are more likely to err by omission than otherwise.

For our purpose we divided the entire period covered, which is 64 years, into five different periods, the first four of which were arbitrary divisions at what seemed to us the fairest points to bring out tendencies truly, while the last period (1881-89) was cut off and excluded from the main table as covering too recent a period for the future career of the graduates in it to have become sufficiently defined. The following is the general result of our abstract:

Years included.	No. of years.	Total No. graduates.	No. grads. who afterward became Chf. engrs.	Prest. or V. P.	Profs.	Total.
1826-42...	17	177	3	8	15	26
1843-52...	10	66	5	9	6	20
1853-65...	13	153	27	33	10	70
1866-80...	15	344	28	83	19	130
Totals.	55	740	63	133	50	246
1881-89...	9	246	6	22	6	34
Gd. tot'ls	64	986	69	155	56	280
(Of whom, now living).....		875				

In a rude way, the proportion of engineering graduates who become chief engineers, presidents, vice-presidents, general managers, or superintendents of corporations, or professors of engineering in reputable schools may be taken as fairly indicative of the proportion who are noticeably successful in the profession for which they were educated. There are many exceptions both ways. Some men are eminently successful who yet never attain any of these titular distinctions, as notably those who obtain subordinate positions in great corporations, or who work into consulting practice or manufacturing on their own account. Others who do attain these nominally high offices do so only for a short time or in small corporations, and then drop back again into lower ranks. But in this particular instance the specific title and position held by each man are given, and it needs but a brief glance through the lists to see that nearly all these nominal offices did in fact represent important and responsible positions, and that the lists, as a whole, therefore, must rather understate than overstate the proportion of graduates who have been conspicuously successful, even after allowing for the few cases of duplications of the same name in these lists, as when the same man has been at different times chief engineer, vice-president and president of the same company.

The only way to make the lists fairly indicative in these cases is to put every name in each list where it belongs. Nevertheless, to eliminate every cause of error, we have been through the lists name by name and discovered just 25 cases of duplication of names, or about 9% of the whole number. This is a trifling proportion which is undoubtedly more than covered by the proportion of those who have succeeded admirably, though not quite to the point which brought their names within this list. We think it a fair inference also that a classification of these unrecorded successful men would show about the same proportion of men who had succeeded either in the strict line of engineering practice or just outside of it.

Whether or not this be admitted, this list covers the careers of the most successful third of the graduates prior to 1881. What have they succeeded in? The showing is most striking and significant, and it is to this especially that we wish to call attention.

It will be seen that more than twice as many of the graduates ultimately become presidents or vice-presidents of corporations as become chief engineers! Is not this a highly significant fact, worthy of serious thought by those who are conducting engineering schools? Moreover, the occasional duplications of names to which we have alluded serve here a very useful purpose. They show to a certainty what proportion of the graduates have reached the higher managing positions by what might be expected to be the usual road for them, i. e., through the highest engineering position. It is only an insignificant proportion. Out of the 34 presidents listed, 3 only have also been chief engineers. Out of the 121 vice-presidents or managers listed, 12 only have also been chief engineers, included in which are the 3 who also became presidents; so that only 12 men out of the 130 to 140 different men who are covered by the 155 cases listed have reached high managing positions via high engineering positions. At least twice as many men as have ever reached the status of chief engineer have jumped from junior engineering positions (often very junior) to the managing positions.

In most cases the purely technical training has been an important adjunct in bringing about this promotion, beyond a doubt; and yet it seems a fair inference that it is about twice as important to an embryo engineer to be fitted to become a leader and manager of men as to be fitted to solve abstract problems. Study of books only will give the last, but to get the first a quite different training, closely analogous to that given in military schools, is better adapted, as we endeavored to show in discussing "The Ideal Engineering School" some months ago.

It is interesting to note also that this tendency seems to be increasing. In the 40 years ending with 1865, 35 men became chief engineers to 50 who became managing officers, or 1 to 1.43. In the succeeding 15 years ending with 1880 the respective numbers are 28 to 83, or 1 to 2.97. Among the younger men who have graduated since 1880 the respective numbers are 6 to 22, or 1 to 3.66; and yet these younger men have hardly had time to develop their full proportion of managing men.

To measure the significance which may be properly given to these figures, it is desirable to know the kind of corporations in which the graduates attain these positions. We have made a little tabulation of these facts below, in studying which it is important to remember that Rensselaer is the only large and old engineering school which graduates civil engineers only, giving a training in mechanical engineering, but not attempting the specializing process which has been carried so far in the Massachusetts Institute of Technology, for example, where there are now seven or eight different courses in engineering, from which a man may graduate. It is, therefore, a perfectly fair inference that the Rensselaer graduate will and does tend to "scatter" less into all sorts of allied occupations than all the graduates together of other schools, though, perhaps, rather more than the graduates from any one course of the specializing schools.

	Prests.	V. P. & G. M.	Total.	Chf. Engrs.
1. Railways	10	35	45	44
2. Canals	.	5	5	3
3. Gas, water and municipal	1	2	3	4
4. Bridges and bridge cos.	5	6	11	8
5. Iron, coal and silver mining	3	20	23	3
6. Rolling mills and iron wks.	2	22	24	2
7. Locomotive and machine work	3	4	7	..
8. Manuf'turing (chiefly iron)	4	17	21	..
9. Street r'ys and electric	..	6	6	4
10. Marine, contracting and dredging	2	2	4	2
11. Banks, hotels and newspapers	3	2	5	..
	33	121	154	70

(There is a transposition of one name here somewhere as compared with the previous list. The error is probably in the latter. The grand total is the same.)

Summary.

	Prests.	V. P. & G. M.	Total.	Chf. Engrs.
1-4. Civil engineering occupations	16	48	64	59
5. Mining engineering occupations	3	20	23	3
6-8. Mechanical engineering occupations	9	43	52	2
9. Electrical engineering occupations (chiefly)	..	6	6	4
10-11. Sundry business occupations	5	4	9	2
Total	33	121	154	70
Of which there are in other lines than strict civil eng'ring,	17	73	90	11
and in civil engineering proper	16	48	64	59

What a "scatteration" is here revealed, in view of the fact that all these men (or most of them) supposed they were going into civil engineering only! Only 59 out of 224 follow civil engineering proper to the end of the chapter; 11 of them branch out from it into other kinds of engineering, and 154 of them branch out from engineering practice altogether into executive positions, of which more than half (90 to 64) are in lines more nearly related to mechanical or mining than to civil engineering!

The plain moral from these figures, it seems to us, is that it is impossible for any young man to foresee with any degree of exactitude what particular kind of engineering knowledge is likely to be most useful to him, while he can foresee with some certainty this fact. He is extremely likely to have both technical and executive positions related to all branches of engineering open before him at some time in his life, and hence what he particularly needs is (1) as good a training as is possible to fit him for executive duties, which he may always expect, and (2) a certain all-around knowledge of all branches of engineering, so that he will not be wholly at a loss in undertaking duties relating to any branch.

If this be true, it follows that the plausible theory of specializing engineering courses, so as to enable the young man to choose a specialty from the beginning and concentrate all his efforts upon that, is, in fact, an unsound and misleading one. We do not assert this to be so, but we have been disposed to believe that it was so for some time past, independently of these records, which seem to indicate it so decisively. The tendency to specialization in after life is unmistakable, and sure to grow still greater, in view of the rapidly enlarging mass of knowledge to be mastered in each specialty, but it by no means follows that specialization of primary schools is expedient.

On the contrary, the question cannot but arise: Is there any better and surer way to lay a sound foundation for the practice of any engineering specialty than to devote the first four years of a young man's professional study to acquiring a sound general knowledge of the theory and practice of all the main branches of engineering? In view of the intimate inter-relations of these branches with each other, and also of the miscellaneous opportunities which present themselves to the graduate in any specialty, we think the judgment of most successful specialists would be that the broad foundation alone with a moderate amount of specialization as between civil, mechanical and mining engineering, is more than enough work for a four-years' course, and is a better foundation for following any specialty later than earlier direct training in it at the expense of a man's general knowledge of engineering. Nay, we may go further,

and we think the actual records presented in this article tend to warrant us to do so. It may at least be plausibly urged that the best of all possible ways to make a man in the end a first rate engineering specialist is hardly to touch that specialty in the four-years' college course, but to devote his best efforts in that brief period to every other branch but that. Then he could buckle down to his specialty in earnest after graduating without being an entire ignoramus as to other branches, of which he is sure to need some knowledge, though he has little chance to gain it in his after life.

But if this be so, how can it be that the tendency is so decided to specialization of courses? There is at least one possible reason which does not conflict with this argument, viz., that it is the more popular course and the more likely to attract students. All the colleges are naturally anxious to do this; it is the popular measure and guarantee of excellence. To tell a possible student the truth, and say to him: "We can't possibly do more than fit you to begin the study of a specialty in a four-years' course, and hardly that," is likely to discourage and repel him. The foolish youth and his more foolish parents are far more likely to be captivated by being told, in effect: "Come to us, if you would be an accomplished specialist, and we will make you one—in just four years"! That, of course, is not said in so many words, but that is the necessary implication from the mere fact of the specialization. Otherwise, why specialize? The very fact of specializing implies that sufficient general knowledge can be given in less than four years, starting from the very moderate requirements which even the best of our schools demand for admission.

LETTERS TO THE EDITOR.

THE AM. SOC. C. E. ELECTION.

Sir: It is very difficult for the great bulk of the non-resident members of our society to form a distinct idea of the policy that would be best for the society to pursue in many of the proposed subjects upon which they are requested to vote. This, of course, makes it extremely important that the committees having the various matters in charge, and to whom we must practically look for advice, should be most carefully formed. For my part, I consider them the only safe guide, but this position has been, in a measure, undermined by the immoderate circular letters that I have just received sustaining their action in the matter of the new candidate for secretary. The snarl of the controversy having unfortunately been stimulated and circulated, perhaps it was proper that a circular, dignified in its form, like the one headed J. H. Bensel and 36 others, should have been sent out, but that it should have been followed by others full of innuendos and personalities when read between the lines, was bad judgment and to be deplored.

I probably belong to a class that would like to act intelligently and for the best interest of the society, and I especially regret that the nominating committee, whose advice I ordinarily feel safe in following, should be placed in a position where they must be compelled to pray for deliverance from their friends.

Yours truly, E. C. Jordan, M. Am. Soc. C. E.

Portland, Me., Dec. 16, 1893.

THE AM. SOC. C. E. ELECTION—CARD FROM MR. G. LEVERICH.

Sir: Please publish the inclosed explanation of a letter addressed by me to a small number of the members of the American Society of Civil Engineers and oblige G. Leverich.

Brooklyn, N. Y., Dec. 14, 1893.

(The communication which accompanies this request for publication is printed below. As we have not been specifically requested to publish any of the numerous other communications on the same general subject which have reached the editors as members of the society, we have not felt authorized to do so.—Ed.)

To the Corporate Members of the American Society of Civil Engineers:

The intended meaning of certain clauses in a letter relating to the secretaryship of the society addressed by me to a small number of members, and kindly included in a late circular issued by Mr. John G. Van Horne, having been misconstrued and it having been erroneously inferred that thereby reflections were cast on the nominating committee and its nominee for secretary, I herewith disclaim such construction, either direct or implied.

The nominating committee doubtless acted after deliberate consideration upon the fullest knowledge and with the wisest judgment it possessed. Composed of members each not less than my peer, and some at whose feet I would humbly sit, I did not and could not question the method or candor of its decisions.

I earnestly advocated the appointment of Mr. Hunt as assistant secretary, insisting that the incumbent "should be a member of the society in one of its higher grades, a man competent to discharge in all respects the duties of secretary and understood to be in training therefor." Fully complying with these requirements he has in this capacity been capable and efficient; that in the position he now occupies he should be adversely criticised or that in any material way he was a party to his nomination, I do not believe. Quoting from a circular letter lately written by Mr. John Thomson, so far as I know "his attitude. . . has been manly, frank and to his credit."

The important question, Shall, under these circumstances now well made known to the members, the assistant replace his principal? remains to be decided by the ballot for officers of the society. Confident that each vote will record a deliberate and unprejudiced choice for secretary, and that the result will tend to promote the harmony, welfare and growth of the society, I am, respectfully, G. Leverich.

Brooklyn, N. Y., Dec. 14, 1893.

EXTENDING ENGINEERING ACQUAINTANCE.

Sir: The editorial in your issue of Nov. 23 on the "extension" of engineering acquaintances was certainly a good piece of advice; but I am going to ask you a question, giving you the condition of hundreds of engineers just now: How are we to do as you suggest in the editorial? Please answer that. The ideas you put forward were just what I intended to do, but every "novel" bit of engineering I have had charge of has stopped for lack of funds to pay off its men and left me very "chilly." When I have plenty of work I do not need the various engineering societies. Engineering News gives us the cream of their discussions anyhow. When I don't have work, I feel too poor to join anything. The case stands now thus: The "novel pieces" of construction I was going to write about are stranded; "the novel pieces" of construction in view that I would like to write about are not yet "floated." I can't join engineering societies. Reason: Busted! As for "faithful performance of duty," let one of those "superiors" drop into the slot of opportunity and see the undersigned cleave unto him. The editorial referred to seems to be merely a variable under the integral sign, approaching my case only as a "limit."

I feel something like the legendary jackass standing on one bank of the Mississippi River with empty stomach, the only fodder "in sight" being on the other bank. He couldn't swim; the water was too deep to wade; there was no driftwood to make a raft, no boat to carry him across, and he hadn't read Wellington's theory of soaring flight, so "what could poor Robin do?" I give it up. Let us hear from you on the subject. Very respectfully, B., M. S., C. E.

Atlanta, Ga., Nov. 28, 1893.

(When our lively correspondent finds it too wet to work he can always cut brush! That is an accepted axiom of good farming which is equally applicable to good engineering. Many a man can trace back his final success to small beginnings in technical work done only for his own information and instruction in periods when he could get no one to pay him for making any other use of his time and capacities. In every such case what seems at the moment a misfortune is really a blessing in disguise—and most men may, if they will, make this case their own.—Ed.)

CONCERNING CEMENT TESTS.

Sir: In reply to your correspondent concerning cement testing (Eng. News, Dec. 7, 1893) the words "coarse" and "fine" were intended to describe sand as ordinarily found, used and spoken of by contractors, etc.

In ordinary work it is invariably the case that "fine" river or bank sand is mixed with clay, loam, etc., and the "coarse" sand is proportionately free from these substances, hence, contains more voids than "fine" sand. This may be accounted for by the "fine" sand being suspended longer in running water, settling with the clay (which approximates the same weight) in the slack water, and along the shores; while the coarser and heavier grains will settle together nearer the channel.

The interstices of perfectly clean quartz sand, in coarse or fine grains, will be in proportion to its weight per unit of measure when dry, and not to the size of the grains, which are always unequal and variable. It is almost impracticable to obtain theoretically clean "fine" sand for general use; we must, therefore, take the circumstances as they exist, and make mortar box tests of more controlling influence. It is mortar that is used to bind masonry, and not cement alone, any more than sand alone. It is manifestly absurd to approve the mortar without a knowledge of the sand or cement. The mortar should be tested, and is equally as dependent upon the sand as upon the cement. Since the quality of sand varies in different localities, it follows that a series of standards for voids and sizes must be adopted, and should be similar to those determined by the Massachusetts State Board of Health for filtration. Having then the sand a recognized standard and constant, the comparative testing of mortars (by standards) can be made with certainty.

There is as much variation in the constitution of cements as of the manufacturers themselves, and their value can only be determined for practical use by testing for comparison, mixed with the standards of sand into a mortar. That there is not a broad, comprehensive work on the physical properties of mortars is surprising, from the flood of literature bearing upon cements. Yours truly, R. A. C.

Philadelphia, Pa., Dec. 11, 1893.

INTERSTATE BRIDGE: CORRECTION.

Sir: In your issue of Dec. 7, 1893, you state, in your article on the Interstate Bridge, at Omaha, Neb., that the weight of the bridge is about 3,000,000 lbs. Having rendered some assistance in designing this bridge, I was of the opinion that the weight is about 4,000,000 lbs. There are already 2,800,000 lbs. of metal in the bridge, and, in addition to this, there is to be considered the weight of the electrical machinery, the house, the wooden floor, and, yet to be added, the cantilevers, with their flooring. I have asked Mr. J. A. L. Waddell, the designer of the bridge about it, and he says that I am right. Respectfully,

Thos. U. Taylor,
Prof. Civil Eng'r'g, Univ. of Texas.

Kansas City, Mo., Dec. 11, 1893.

EARLY PILE RAILWAYS.

Sir: Will you, through the columns of your paper, give the reasons for the action of the railway company here referred to? "About 1842 the New York & Erie R. R. started the construction of a roadbed between Birmingham and Elmira and beyond, by driving piles. After spending a large sum of money (reported as $2,000,000) in pile-driving and bridge building, the whole was abandoned and an earth embankment was constructed on a line nearly parallel to the first-mentioned line.

"The piles were driven about 3 ft. c. to c. (in direction of track), and cut to grade." Yours truly,

E. P. Humphrey.

Madison, Wis., Dec. 5, 1893.

(In 1842—and this system of construction is still older than that—railway construction was in its infancy; timber was abundant, labor was scarce and grading little understood. Mistaken ideas as to the necessary exactitude of level and how to secure it were also current, while the rails themselves were chiefly of wood protected by a light iron strap. Under these circumstances the notion that it would be cheaper and better to carry the roadbed on piles exclusively, with hardly any grading, became current, and so rigidly was this principle applied that even when a little excavation through high ground seemed necessary piles were driven through the cut just the same.

A nearly complete line of railway from Hornellsville, N. Y., to Toledo, O., and thence to Detroit was projected and worked upon by various companies at about the date named, and considerable relics of their work are still visible at many points along the line of the Erie and of the Lake Shore & Michigan Southern lines. That along the line of the Erie was done, we believe, by the original Erie company itself and covered some long stretches both east and west of Hornellsville, but it was reserved for the companies working farther west to lay down the broad principle that the whole of the track should be thus supported on piles. The fallacy of this principle was soon discovered, and only short sections of track thus built were ever operated, and that for a short time only. A paper on these railways was published in our issue of Oct. 6, 1892.—Ed.)

COST OF LAYING SEWERS AT NEW BRUNSWICK, N. J.

Sir: Referring to your humorous editorial in your issue of Oct. 12, 1893, on "Important Discovery in Engineering, Made by Common Council of New Brunswick, N. J.," we take pleasure in furnishing you with the following items:

Since the abolition of the Sewerage Commission, five years ago, all public work here has been carried on under the immediate supervision of Common Council.

Considerable work has been completed under their control in a very satisfactory and economical manner.

While the Common Council has general charge of all work, the Street Commissioner and City Surveyor are directly responsible for the faithful performance of all contracts or work which may be undertaken by the city.

The sewer work referred to consisted of laying 375 ft. of 18-in. pipe, 675 ft. of 15-in. pipe, three manholes and 40 Y branches, the average depth of excavation 9 ft. including 900 cu. yds. of red shale rock. The character of this rock is very uncertain; some can be removed with pick and shovel, while some requires blasting.

After advertising the following bids were offered: $2,981, $3,442, $3,610, $5,032. The unexpended balance of appropriation available was $2,000. The Common Council then authorized the construction of a small portion of the work to ascertain the exact character of the rock, and the result was so entirely satisfactory that the whole work was undertaken and has been completed at a total cost of $1,500, an actual saving to the city of $1,481.

The work has been done in the most thorough manner, each pipe has been laid to exact grade, with joints calked with oakum and cemented with "Saylor's Portland." "He who laughs last, laughs best."

Yours truly, Asher Atkinson, C. E.
City Surveyor.

New Brunswick, N. J., Dec. 5, 1893.

(Far be it from us to criticise any one for trying to find out beforehand, so far as possible, what difficulties lie concealed in a proposed work. Our ridicule was aimed not at all at this method of procedure, but at the published statement that by the actual laying of 25 ft. of sewer the cost per lin. ft. of laying over 1,000 ft. was claimed to be ascertained. Doubtless neither our correspondent nor the members of the Common Council were responsible for the rather misleading manner in which this was stated by the reporter; but such publications have an influence with the public all the same, and need to be ridiculed by engineering journals.

With reference to the figures given by our correspondent, perhaps if the contractors had been informed beforehand as to the nature of the material, the bids received would not have varied so widely and would have been nearer the actual value of the work. We have often alluded to the evils which arise from asking contractors to accept unknown risks; and no responsible contractor will bid on such work without making allowance for handling bad material. From what our correspondent says as to the variation in the character of the rock in the trench, it would seem that borings (or better, test pits) would have given a much better idea of the probable cost of the work than laying complete 25 ft. of sewer.—Ed.)

SURFACE DRAINAGE AT STREET INTERSECTIONS.

Sir: I have recently completed a line of electric road, extending from Dedham to Mattapan, a distance of about 5¼ miles, known as the Norfolk Suburban St. Ry. The engineers were E. Worthington, Jr., & Co., of Boston. The line crossed two gutters, caused by the intersection of cross streets, with the street traversed by our road. No connection could be made with sewers, so the problem of providing a drainage passage across our track became a question of considerable discussion.

It was proposed to drain under the track through a cast iron pipe, but the grade of the cross streets was insufficient in each case, without necessitating an extravagant length of pipe in order to meet the surface of grade.

It was also proposed to lay pipe under the track, with catch basins at either end, to allow an overflow from the basins when they should become full. I considered the danger of filling and freezing too great to sanction this method.

Another proposition was to conduct the drain under the track by means of a very wide and shallow culvert with cast iron covering plates. The cost of this latter method would be excessive, as special castings of extra thickness would be required, and the length of such a culvert would necessarily be great, although not so great as in the case of the iron pipe.

I found that by depressing the track and raising the gutter I could carry the drainage over the track on a concrete bed, giving a uniform grade of ⅜ in. in 10 ft. and using only about 100 sq. yds. of concrete. This would cost less by far than any of the above plans, and in my opinion, give good satisfaction.

I consequently adopted this latter means of drainage and have completed the concrete work, which presents a smooth and evenly graded gutter, improving the street largely. I encountered considerable opposition, it being said that more or less difficulty would be caused by snow and ice.

I should be greatly pleased to have your opinion or that of any of the readers of the Engineering News concerning the best method of drainage in similar cases. Yours truly, Thos. T. Allard.

Dedham, Mass., Dec. 4, 1893.

(From the information given it appears probable that the method adopted was the cheapest which promised to be permanent. It is proper to point out that the difficulty would never have arisen if the street intersections had been properly made originally, so that the water in the gutters could have been carried through shallow culverts. This might have been done by building the culverts at the lowest admissible level and grading the streets at the intersection to cover them. The slight rise thus formed would seem far preferable to the ditch of water caused by carrying the gutter across the street, a practice which is sure to be more or less of a nuisance at all times, and little short of intolerable during the winter and spring thaws of a cold and snowy climate. Where storm sewers are in use of course such a problem would not arise. If any of our readers think they have solved a similar problem in a better way than that described in the above letter, we should like to hear from them.—Ed.)

LOGARITHMIC CROSS-SECTION PAPER.

Sir: I notice in Engineering News of Nov. 30, p. 433, under the heading "Society Proceedings" that at a meeting of the Association of Engineers of Virginia Mr. S. R. Henderson presented a specimen of the logarithmic cross-section paper described in your issue of Sept. 28, and stated that it is manufactured by Andrus & Church, of Ithaca, and costs 60 cts. per quire.

Will you permit me to state in correction that this paper is now manufactured and sold by Messrs. Keuffel & Esser, of New York city, and any inquiries concerning it should be addressed to them.

Very truly yours, W. F. Durand.

Ithaca, N. Y., Dec. 5, 1893.

MAGNETIC VARIATION FROM HAT RIMS.

Sir: While reading the letter of Mr. Edward P. Adams, published in your issue of Nov. 30, upon "Unexplained Magnetic Variation," I was reminded of another source of error discovered some time ago. It is the steel stiffening in some Derby hat rims. While my hat had no effect upon the needle, that of an assistant drew the needle perhaps 45°.

Yours truly, Frank Bruen.

Dayton, O., Dec. 9, 1893.

ENGINEERING NEWS THESIS COMPETITION—STUDY OF RAILWAY TRACK JOINTS.

Sir: I beg for a moment in which to refer to your recent editorial concerning awards on graduation theses. May I say that especially do I feel the entire justice of your remarks on the third "Honorable Mention" paper ("An Experimental Study of Railway Track Joints"), of which it is mine to claim authorship?. I realize more than I once did that it is a serious business to attempt to decide, in the light of a few experiments, upon the merits of devices in open competition for favor in the eyes of railway officials. Moreover, like many of my competitors, I was hard pressed for time for three reasons: (1) Distance of work from university, 60 miles; (2) extra work. (3) special causes which rendered absence very dangerous to chance of graduation.

As these restraints are now removed, and as I am assistant to the Engineer of Maintenance of Way on the above road (Zanesville & Ohio River), upon which the experiments were made, I hope, during the coming three months to continue the experiments, since we have all the apparatus with track undisturbed and with the same conditions still obtaining, excepting that we now have some solid coal trains north and trains of empties south. These, compared with local freights, may develop some facts in connection with diagrams already submitted, which may be of some scientific value. I shall be glad if occasion seems to present itself to give you the opportunity of deciding as to whether they will be of interest to the profession. It has certainly been very gratifying to me to have notice taken of our opening effort, and feel that all justice has been done, and more. I beg to say also that I have been a subscriber to your journal for two years. Very respectfully yours, G. E. Hayward.

Zanesville, O., Dec. 15, 1893.

(While this letter was possibly not intended for publication, it will, we are sure, be read with interest. As we stated in commenting on this thesis, it opened up a promising line of investigation which, with a sufficiently varied series of tests, promised to lead to valuable results.—Ed.)

WATER PURIFICATION IN AMERICA.

(Continued from p. 427.)

The Old Infiltration Basin and New Covered Well and Reservoir at Waltham, Mass.

From 1873 to 1891 the water supply of Waltham, Mass., was drawn from an open infiltration basin about 30 ft. from the shore line of the Charles River, having a bottom area of about 5,700 sq. ft. and a depth of 8.4 ft. below the average water level of the river. In 1891 the supply was increased by sinking a well in the bottom of the basin to a depth of 18 ft., or 26.4 ft. below the average water level of the river. In 1893 the well and basin were covered to exclude light and prevent algae growths. Fig. 5 shows a plan and sections of the well and basin.* With the sinking of the well the remaining portion of the basin was converted into a storage reservoir.

It appears that algae growths in the water of the basin have given trouble ever since it was put in use. In the annual report for 1883 the commissioners state:

> The filter basin is now in excellent condition. We have tried from time to time many expedients to keep down the rank growth of algae. The experiment with the chain, described in a former report, gave excellent results for a time, but there still remained a large amount of sediment in the basin, showing that after being cut off, the algae did not all rise to the surface. This year a fish seine was purchased, and by drawing this through several times and finally covering it with mosquito netting for the purpose of taking out the fine sediment, we have been able to thoroughly clean the basin. We think it should be cleaned in this manner at least once a year hereafter.

The same report calls attention to the fact that during the year the capacity of the basin was severely taxed, there having been pumped for 16 consecutive days over 900,000 gallons daily, the pumps running about 14 hours out of the 24. During part of this time there was water enough to supply only one engine and that running at a low speed. In 1886 the basin was connected directly with the river, but it was not necessary to make use of the connection during that year.

In 1886 a report on an increased supply was made by Mr. T. Howard Barnes, of Waltham. In this report it was stated that the highest amount pumped during the dryest preceding periods were at the rate of 883,394 gallons per day for 100.9 hours, included in Sept. 11 to 17, 1893, and 1,042,429 gallons for 113 hours, July 9 to 16, 1886. The former rate equals about 155 and the latter 183 gallons per sq. ft. of bottom area of infiltration basin.

On Sept. 10, 1886, Mr. Barnes states that a seven-days test of the capacity of the well was made, the yield being a gradual diminution, with one exception, from 1,200,000 gallons the first day to 1,138,000 the seventh day. During the test the pumps were run so as to keep the water as nearly as possible at a uniform level, in the belief that more water could be secured by extending the pump run throughout the whole 24 hours than by drawing the water down to the suction limit and then stopping a while. At the beginning of the second day's pumping the water in the basin was 3.64 ft.; at the beginning of the fifth, 3.96 ft., and at the close of the seventh, 3.7 ft. below the water in the river, the variation being principally due to the river. Four hours after the pumps were stopped the differences in water levels had decreased from 3.7 to 2.3 ft., and 24 hours after to only 0.92 ft. Observations in adjacent test wells seemed to show that about two-thirds of the yield of the basin was from ground water in the surrounding territory, while from other data Mr. Barnes concludes that but little of the water in the basin passes to it directly from the river, that not derived from the surrounding ground water probably coming from a distance. Under the authority granted it to build works, the city at this time had a right to draw up to 1,000,000 gallons per day

* The drawings from which Fig. 5 is reproduced accompanied a brief paper describing the roof of the well and basin, read Dec. 13, 1893, before the New England Water-Works Association. Some of the information here given regarding the well and basin is from the paper, and the discussion upon it, but most of it is from the annual reports of the Waltham water-works and the Massachusetts State Board of Health. Mr. Johnson's paper related solely to the roof, and will be published in full in the Journal of the New England Water-Works Association.

from the Charles River. This, it appears, has since been increased to 3,000,000 gallons per day.

Mr. Barnes concluded that with a head of 3.7 ft. the basin might be safely depended upon for 1,100,000 gallons per day, or about 193 gallons per sq. ft. of basin area, but that by deepening the basin the yield might be increased, while by extending it to cover more area it would not be, to any great extent.

In 1887 Mr. M. M. Tidd, M. Am. Soc. C. E., of Boston, directed the sinking of a 5-in. experimental well to a depth of 83 ft., at which depth water was found which did not fluctuate with the water in the basin, although water struck at 45 ft. did so fluctuate. Wells or a new infiltration basin were proposed by Mr. Tidd.

Nothing further seems to have been done, for in the commissioner's report for 1889 the necessity of an additional supply is mentioned. Reference is made to serious trouble caused by algae growths and it is stated that possibly it may become necessary to cover the basin to exclude light and prevent these growths.

In 1891, Mr. Frank L. Fuller, M. Am. Soc. C. E., of Boston, was engaged as consulting engineer, and a well 40 ft. in diameter and 18 ft. deep was sunk in the bottom of the basin, as shown by Fig. 5. Mr. Fred. E. Shaw, of Providence, was the contractor for this work, the contract price being $8,940. The well was walled up with dry rubble masonry with a 16-in. brick lining from a point 3 ft. above its bottom. The capacity of the well was thought to be at least 5,000,000 gallons, or nearly 4,000 gallons per sq. ft. of bottom area. To June 1, 1892, the maximum daily consumption is reported as 1,592,000 gallons, while the average for the year 1892 was 922,000 gallons.

Although an ample supply was thus obtained, the trouble from algae growths does not seem to have been diminished. An interesting account of the general quality of the water and the means which might be taken to improve it was given by the Massachusetts State Board of Health (see report for 1891-2, p. 48) on Nov. 3, 1892, in response to a request for advice. Omitting unessentials to this discussion the letter of advice was as follows:

The examinations indicate that the water as it comes from the ground into your well and filter basin, whether derived from the Charles River or from territory which contributes water directly to the well, is very thoroughly purified by its passage through the ground, so that it is colorless and free from odor and contains only a small amount of organic matter. In the well and filter basin, however, before it is pumped, its quality rapidly deteriorates and it develops at times a disagreeable odor, owing to the rapid growth of certain low forms of vegetation in the water. After the water is pumped to the reservoir still other vegetable forms appear, many of them minute microscopical forms which are suspended in the water and render it slightly turbid. These minute forms, either in the reservoir or after they are drawn into the pipes with the water, are probably the chief cause of the disagreeable tastes and odors observed at times in the water as drawn from taps in the city. In addition to the direct effects of this vegetable growth, both the fresh and the decaying vegetable matter help to support animal life.

The remedy for all these troubles is, as suggested in the former reply of this board to the city of Waltham, dated March 3, 1891, the exclusion of light from the water from the time it comes from the ground until it reaches the consumer. This would prevent all of the vegetable growths which are now found in the water and would indirectly prevent animal growth, as its supply of food would be cut off. There is no reason to think from the experience obtained with other Massachusetts water supplies that a water of as good quality as that which now comes into your well and filter basin would support any growth which would cause it to deteriorate in quality if light was excluded.

The best method of excluding the light is a matter for study and decision by your board. The walls of the well might be raised above high-water mark and covered with a roof, and the surrounding basin might be filled in without affecting the ultimate capacity of the supply. If, however, it is thought necessary to preserve the storage capacity of the basin, so that the water can be pumped more rapidly for a limited time, the portions outside the well might also be covered. Covering the present distributing reservoir would be effective, but somewhat difficult on account of its shape and size, so that some other method may be cheaper or possess additional advantages. If, as suggested by members of your board, an increased pressure is desirable in some parts of the city, it may be best to build a new reservoir or tank at a higher level and of sufficient size for all ordinary uses, reserving the present reservoir for use in case of fire or other emergency. There is reason to suppose that covering the well and filter basin would improve the quality of the water, but no great improvement could be expected if the water is exposed to the light at any place.

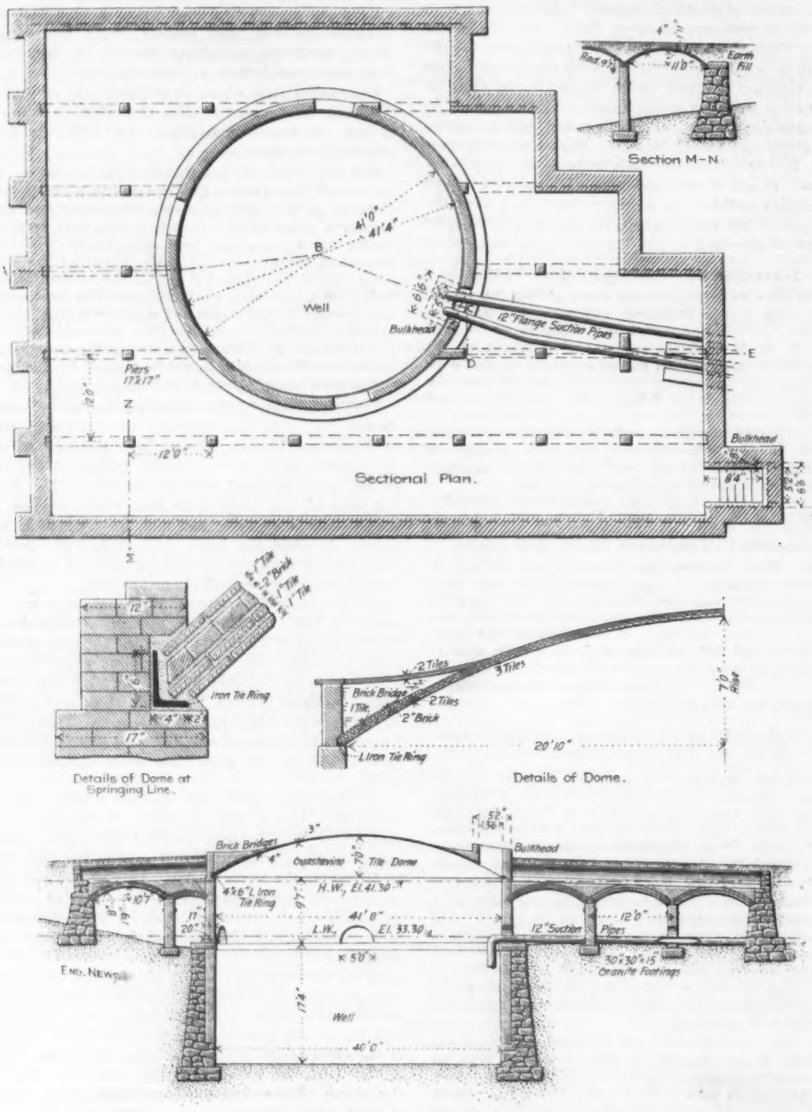


FIG. 5. COVERED WELL AND RESERVOIR AT WALTHAM, MASS.

In the fall of 1893 the basin and well were covered in the manner shown in detail by the plan and sections, Fig. 5, at a cost of about $6,000. All the work except the roof proper of the central well was done by the city. The well roof, or dome, including the iron angle tie ring and the so-called bridges shown in the drawings, was built by the Guastivino Fireproof Construction Co.,* Pierce Building, Boston, and 35 Broadway, New York, for $1,916.

As will be seen by Fig. 5, the dome is of a very light and bold form of construction, being about 40 ft. in diameter and composed of three layers of tile, making a total thickness of about 4 ins., except for about 4 ft., near the springing, where there are four layers of tile and one of brick, laid flat. Alsen Portland cement was used.

Mr. Frank P. Johnson, City Engineer of Waltham, was the engineer of the work and states that in the work done by the city American cement, mostly Hoffman, was used, but the cement was put in place in about two minutes after mixing and the brick were previously soaked in water. Mr. Geo. E. Winslow is Superintendent of the Waltham water-works.

The Covered Reservoir at Brookline, Mass.

Brookline, like Waltham, drew its water supply for many years from saturated gravel adjacent to the Charles River, but from covered infiltration galleries, instead of an open infiltration basin. Recently the Brookline supply was increased by sinking a number of tube wells near the river. The water as pumped from the galleries, and latterly from the wells, has always been of a satisfactory character, but after passing to the reservoir, and in recent years to the high service tank, algae developed to such an extent as to make the water very disagreeable in taste and odor. The subsequent covering of the tank stopped the trouble at that point and long-continued and careful microscopical studies of the reservoir water, made by the Superintendent, Mr. F. F. Forbes,** coupled with great care in pumping and distributing it, have to a great extent ameliorated the objectionable qualities of the supply. But for all this it was sometimes necessary to use water from the reser-

* See Eng. News, Nov. 9, 1889, for illustrated description of this company's system of tile arching.

** See Journal, New England Water-Works Association, Vol. IV., pp. 196-210; Vol. VI., pp. 90-7.

voir which was almost intolerable. The only recourse was to exclude light from the water until delivered to the consumers. The reservoir has a capacity of 6,000,000 gallons, is oval in shape, with axes of 130 and 360 ft. The shape of the old reservoir was not considered suitable for economical covering and its storage capacity could not be dispensed with while a roof was being built. These and other considerations led to the construction of a covered reservoir, near the old one, which

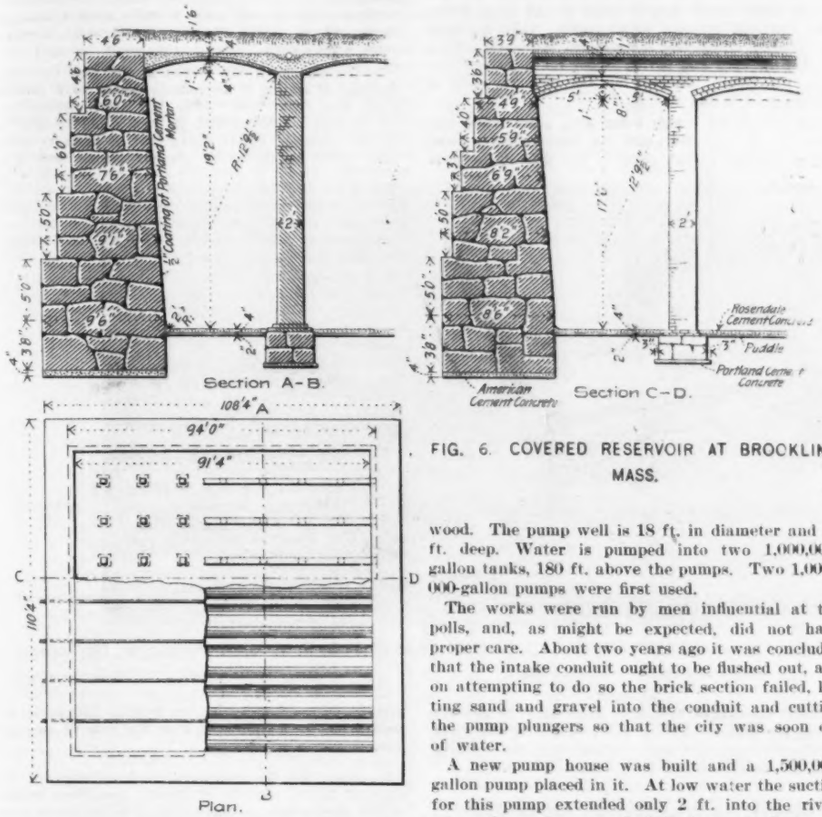


FIG. 6. COVERED RESERVOIR AT BROOKLINE, MASS.

was completed a year or so ago, with Mr. Forbes as engineer. It has a capacity of about 1,000,000 gallons and is fully shown by the accompanying plan and sections, Fig. 6.*

The concrete covering the roof of the reservoir was treated with cool tar and sprinkled with sand. The walls of the reservoir and the piers, to a height of 15 ft., were laid in American cement. The rest of the brickwork is in Portland cement, which material was also used for the concrete covering. The other material, the dimensions and details of construction are shown by Fig. 6. The cost of the structure was about $27,000.

Strange to say, after the water has stood a certain time in the uncovered reservoir, no more being pumped in, the number of algae decreases. This makes it possible to get along for the present with the small capacity of the new reservoir, drawing upon the old one only in case of emergency.

*From drawings accompanying a paper by Mr. F. F. Forbes, Superintendent of the Waltham Water-works, read Dec. 13, 1893, before the New England Water-Works Association. The paper will be published in full in the Journal of that body. Most of the information here given, aside from that on the drawings, is based on the reports of the Brookline Water Board.

CLEARING A WATER-WORKS INTAKE AT PARKERSBURG, W. VA.

By Frank Schefold.

The water-works of Parkersburg, W. Va., were built by the city in 1885, water being taken from the channel of the Ohio River, at a point where the water is never less than 8 ft. deep, through a 3-ft. intake conduit. The first 208 ft. of the intake from the pump well was built of cast iron, the next 90 ft. of brick and the last 500 ft. of wood. The pump well is 18 ft. in diameter and 45 ft. deep. Water is pumped into two 1,000,000-gallon tanks, 180 ft. above the pumps. Two 1,000,000-gallon pumps were first used.

The works were run by men influential at the polls, and, as might be expected, did not have proper care. About two years ago it was concluded that the intake conduit ought to be flushed out, and on attempting to do so the brick section failed, letting sand and gravel into the conduit and cutting the pump plungers so that the city was soon out of water.

A new pump house was built and a 1,500,000-gallon pump placed in it. At low water the suction for this pump extended only 2 ft. into the river, where the water was only 1 ft. deep. An L, turned downward, was placed on the end of the suction pipe and the pump was sometimes filled with sand. An 18-in. siphon, with a rise of about 12 ft., was laid from the river to the old pump house. No provision for priming was made, and upon being called in I found that it did not work and that all water was being taken directly from the edge of the river. These improvements, if they could be called such, cost about $16,000.

I first proposed to connect the 18-in. pipe direct to the pumps and extend it to the channel. But finding the 500 ft. of wood pipe all sound, I decided to make an effort to clear it, although the sand in the conduit was in no place less than 5 ins. from the top and in some parts completely filled it.

The first attempt at flushing reopened the brick section which had just been repaired. The whole of this section was then replaced with cast iron pipe and a line of hose run out to near the mouth of the conduit and sand loosened in 40-ft. sections, the river being 24 to 30 ins. above the top of the conduit. After having loosened the sand and gravel, I commenced flushing from the pump well. The first three days I could only open the 36-in. flush gate 1 to 2 ins., with a gain of only 1 to 2 ins. in the conduit, but the fourth day the gain was greater. The fifth day no gain was made and after an examination I found that the gravel which had been drawn in at the first break of the conduit had covered the top of the sand, so the flushing had no further effect. By using the hose again, and by holding the stream below the gravel, I drowned the gravel in the sand. A sand bar 7 ft. high which had formed at the mouth of the conduit was also washed away by the hose jet. The next flushing was very successful. Toward the last I could completely open the flush gate at the start, gravel and sand went out together, and on the eighth day the conduit was clear from end to end.

As a further illustration of the former management of the works, it may be stated that in a boiler of the locomotive type they used cold feed water and had only 6 ins. of steam space. The boiler was over 100 ft. from the pump and the engineer, when at the pumps, could not hear nor see his steam gages or safety valves. No meters are wanted, although the daily consumption for 8,000 people is 1,500,000 gallons. (The population in 1890 was 8,408.—Ed.)

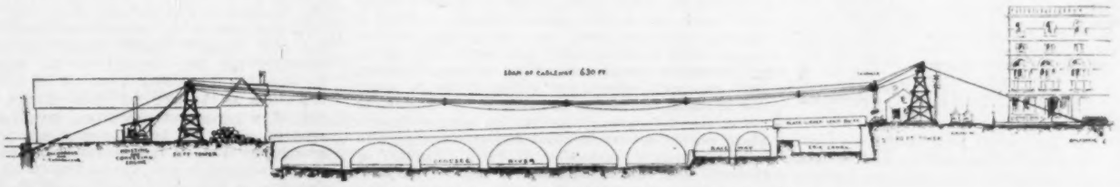
The works are now under the management of Mr. S. T. Wells, who was employed on them during their construction and has been called back recently to put them on a business basis.

THE USE OF WIRE CABLEWAYS AT THE COURT ST. BRIDGE, ROCHESTER, N. Y.

The very great usefulness of the cableway in laying long lines of heavy masonry, as in masonry dams, retaining walls, etc., is becoming quite generally recognized by contractors and engineers. In our issues of Jan. 26 and Aug. 17, 1893, we illustrated and described the Locke-Miller cableways used at the Austin, Tex., and Butte, Mont., dams, and in our issue of May 18, 1893, that used in laying the masonry of that portion of the Baltimore Belt tunnel constructed in open cut. The accompanying illustrations show the application of the same cableway to the construction of the Court St. bridge over the Genesee River, at Rochester, N. Y.

This bridge, of which a preliminary description was given in Engineering News of Feb. 2, 1893, is of the stone arch type and replaces an old one, which consisted of several short spans supported on comparatively light masonry piers, and which had become entirely inadequate for the increased traffic at that point. Its total length is about 500 ft., including the iron plate girder span of 80 ft. over the Erie Canal, which runs close to one bank of the river.

For the construction of the bridge the contractors, Messrs. Lauer & Hagaman, introduced two Locke-Miller cableways, manufactured by the Lidgerwood Mfg. Co., of New York city. These were erected side by side spanning the river, and 60 ft. apart, in order to cover the full width of the bridge, 64 ft. The two cableways were identical in every respect and independent except that one



LOCKE-MILLER CABLEWAYS AT COURT STREET BRIDGE, ROCHESTER, N. Y.

boiler supplied steam for both. The capacity of maximum load handled by each was four tons, which was the weight of some of the heaviest blocks; the smaller stones and other material, such as cement and gravel, were loaded into skips, which were suspended from the fall block of the carriage. All material, although the bulk of it came from one side, was picked up and delivered at any point along the line with the greatest ease and entirely under the control of the engineer, a conveying speed of 500 ft. per minute being easily attained.

The wooden towers at either end for the cables were 50 ft. high and were made of 10×10-in. pine timber. The clear span between the towers was

630 ft., and the diameter of the cables, 1¾ ins., steel. The engines were double cylinder 8¼ × 10 ins., reversible link motion, 30 HP., with large drums for high speed. One 40-HP. boiler supplied steam for both.

A very important part of the work assigned to the cableways was the removal of the old bridge piers, etc., and the removal of about 5,000 cu. yds. of rock from the bed of the river, and at the abutments. The cableway being overhead, was well adapted for this work, as it was out of the way of the blast and was not affected by the high water, ice or driftwood. Another feature of the device was its use for dragging material from quite a distance at either side into position under the line of travel, and carrying it from there to any desired point without transferral.

On account of the width of the bridge, several transverse travelers were employed to facilitate the laying of stone. These ran on temporary wooden rails, the span corresponding to width of bridge. The blocks of stone or other material were delivered from the cableways directly onto the traveler, and were then carried across and set in place. This method allows full capacity of the cableway for delivering material and saves delaying the cableway to set stone as with a derrick.

In addition to the above description, City Surveyor J. Y. McClintock furnishes the following details of the operation and uses of this cableway:

The first stone was laid April 1, and the last Oct. 7, 1893; at the present time the structure is practically completed. The estimated quantities for the bridge, all of which were handled by the cableways, were as follows:

Earth excavation	2,200 cu. yds.
Rock excavation	4,700 cu. yds.
Lumber in centers	350,000 ft. B. M.
Masonry in piers and arches	2,200 cu. yds.
Arch stones	2,278 cu. yds.
Concrete for spandril backing	2,060 cu. yds.
Coping	868 lin. ft.
Gravel	3,400 cu. yds.
Ironwork	310,000 lbs.

In the iron bridge over the canal the floor beams are 40 ft. long and weigh several tons. These were put into place by taking hold of each end by a carrier and working the two cableways simultaneously. Stones were laid both in the piers and arches, not only under each cableway, but midway between the two; that is, 30 ft. distant at right angles from either. This was done by hitching the hoist from each cableway on to the stone, and hoisting on one while paying out on the other, thus dropping the stone into exact position. This feature was extremely advantageous to the contractors in laying all of the heavy skewback stone on the last piers, when the high water had carried away the derrick frame which was used in laying the other piers, and as the water still kept high, it seemed unadvisable to build another frame for the few yards of stone remaining to be laid.

To lay the piers a frame was used which straddled the piers and on the top of which traveled a carrier. The cableways were used to bring the stone to the piers, and it was carried sideways by these carriers. After a pier was completed, this whole apparatus was taken hold of by both cableways, and in 10 minutes set over on the site of another pier. This was such a simple matter that in some cases where the stones intended for a given pier were not at hand, the frame was moved to another pier, and when the stone on hand there was used it was moved back to finish the first pier. The wooden centers for the arches were made very heavy, and were framed on a horizontal platform and lifted into place. For this work also the cableways were found very handy.

On account of the limited space available, the carriers were used for pulling the old piers out and removing 5,000 cu. yds. of stone blasted from the bed of the river. They carried stone to the crusher and then delivered concrete to all points. They deposited the spandril filling, laid the spandril walls and coping, carried the curb and paving stones for the street surface, and, finally, dragged out the immense mass of timbers used in the centers.

The site of the bridge being at a point where the river bed is very steep, and the Genesee River being subject to very sudden rises, it was difficult to build ordinary falseworks and have them stay in position during the season. During the progress of the work the river was several times so high that the ordinary form of conveyor would have been carried away.

VIEW OF THE LOCKE-MILLER CABLEWAYS AND PARTLY COMPLETED BRIDGE AT COURT ST., ROCHESTER, N. Y. J. Y. McClintock, City Surveyor Lauer & Hagaman, Contractors.

SMOKE ABATEMENT IN ST. LOUIS.*

Two inspectors of smoke nuisances have been busy on preliminary work for the past two months, and prosecutions are now about to be started against offenders, for which purpose a special attorney has been secured by the Citizens' Executive Committee. A month's notice was served on offenders after having been reported by the inspectors, after which time they will be prosecuted if they do not abate the smoke. The Smoke Prevention Committee has thoroughly tested only three devices, the Hawley down-draft, the Boileau and the zig-zag grate bar, but about 50 different devices for preventing smoke are in use in St. Louis, some of which are quite extensively and successfully used. Difficulty is found in getting accommodations for testing new devices, but five more are to be tested next month. The steam jet principle is used in many of the devices, the down-draft in several others, and coking arches in others and so-called combustion powders or compounds, to add to coal before or during use, are being advocated. These usually consist of about 25% of saltpeter with salt, sulphate or carbonate of soda, carbonate of ammonia, etc., and are supposed to improve the combustion, prevent smoke and slag the ashes, but they are valueless, as the amount of saltpeter is too small to do any good, as only 3 lbs. of powder is used, while the trouble with the ashes is that they are too fusible already, and hence clinker on the grate-bars. The work of the committee has resulted in creating a demand for better designed boilers and greater care in operating, besides abating the smoke, while more care is being exercised in selecting fuels, and probably coal will soon be sold on the basis of heat units capacity in this market. The steam jet principle is usually quite effective in preventing smoke, but generally at a slightly increased consumption of fuel. In one case, however, an economy of 18% has been attained with a steam jet where a bed of 15 ins. was carried on a hard worked boiler, though when the thickness was increased to 20 or lessened to 8 ins. there was a loss in economy and capacity. The down-draft type is not only effective in preventing smoke, but increases the efficiency and economy of the plant, and 40 to 45 lbs. of coal per sq. ft. of grate surface, with a good draft, or 50 lbs. with strong draft, can be burned on down-draft grate-bars. The Wabash R. R. is successfully preventing smoke on its locomotives by a combination of a steam jet and a baffle arch, which latter does away with the excessive noise of the jet. A new down-draft device has been brought out in London, England, for domestic stoves and ranges that is quite successful, and promises to solve the smoke problem from dwellings. Smokeless fuels, like coke, anthracite, oil and gas are available, which not only prevent smoke, but are much cleaner, while crushed coke is little more expensive than coal.

In the discussion Mr. Bryan stated that the extra expense of adding a down-draft device to a 100-HP. plant was about $800, while Mr. Moore added that an economy of about 23% in fuel could thereby be saved. Professor Potter stated that no ordinary grate bars would satisfactorily prevent smoke, over long periods, where the care of the fireman had to be depended on, no matter how slow the rate of combustion.

*Abstract of a paper read Nov. 15 before the Engineers' Club of St. Louis by Prof. W. B. Potter.

Proposals for the construction of railways in the state of Bahia, republic of Brazil, have been invited by the government of that state, as noted in our issue of Nov. 30, and we have since received from the Brazilian Consul-General in London the official circulars giving particulars of the lines. Six railways are contemplated, about 435, 362, 203, 270, 136 and 63 miles long, all of meter gage, while branches for freight traffic only may have a gage of 24 ins. In addition to grants of land the government will guarantee interest, not exceeding 7%, for the maximum term of 30 years, on the capital necessary for construction, provided that the cost does not exceed $30,850 per mile. The proposals will be received until Dec. 31.

The movement for the establishment of the Columbian Museum on a grand scale in the city of Chicago, as a memorial of the World's Columbian Exposition, has now assumed definite shape, and the sum of $1,500,000 has been secured for the endowment of the same. It is proposed to use the Art Gallery of the Exposition as the museum. This building is of brick and of a permanent character, excepting its outer covering, which will be, in proper time, made of more durable material. It is proposed in the establishment of this museum to give special importance to the engineering or technological section, which will be distinct from and not in any wise under the control of the anthropological and natural history sections. It is confidently expected that a magnificent institution will be established, which will be of the highest permanent value to all interested in any way in engineering, and especially in the science of transportation. Mr. Willard A. Smith, Chief of the Department of Transportation Exhibits, has arranged to take immediate care of everything offered for the museum in the Transportation Building and to see that it is turned over in proper shape when permanent arrangements have been duly effected.

While the use of portable or sectional railway track is very common in many countries, it has not been adopted in the United States to any extent, its use being practically confined to plantations in Louisiana. In Europe and South America it is used extensively on large engineering construction works, mining works, pioneer railways, etc., and several European firms manufacture exclusively the track and rolling stock

for portable and light railways of 12 to 30 ins. gage for either horse or locomotive traction. Few of these firms were represented at the Columbian Exposition. Achilles Legrand, of Mons, Belgium, showed specimens of track with 10 to 40-lb. T-rails, riveted to channel iron ties in sections 4 to 16 ft. long. Special sections are made with long files carrying switches and crossings. Lumber, cane and dump cars were shown of various sizes and patterns, all fitted with axle boxes having in the top an oil hole closed by a set screw. A key tapped into the end of the journal strikes the oil at every revolution and splashes it over the journal. A small section of the Lartigue railway, with rails carried on A frames, was also exhibited. H. Kaehler, of Gustrow, Germany, showed lumber cars for use in forestry works, etc. Breymann & Huebener, of Hamburg, showed models of various kinds of track and equipment, and their system is largely used on the North Sea and Baltic canal works. The Daimler Motor Co., of New York, had a small petroleum motor car running on a 24-in. gage portable track, of German manufacture, with ties of Haarmann section. On one of these tracks the rail ends were cut with a vertical bevel. C. W. Hunt & Co., of New York, manufacture light narrow-gage track, but mainly for permanent use about manufacturing establishments. The advantages of the portable track are the facility and rapidity of moving and laying to keep up with the work as it progresses, either in engineering construction or for plantations, timber clearing, etc.

The Colorado Irrigating Company, says a San Francisco press dispatch, has been organized to build a 400-mile canal to irrigate 1,200,000 acres of the Salton Desert. The estimated cost of the canal is $5,000,000, and it is to be feared that the company will have to await better times before they can commence operations. This desert is the one flooded last year by a diversion of the Colorado River.

A multiple traveling electric crane has been devised by Mr. F. Feikel, of Chicago, Ill., for use in railway freight houses which would seem to possess some advantages in certain cases. It consists in brief of building an ordinary bridge crane with several parallel tracks, on each of which a separate trolley moves. Of course this makes a bridge of unusual width. Each trolley is operated independent of the others and is arranged to be as nearly as possible automatic in taking up and depositing its loads.

The adoption of improved types of rolling stock on Australian railways was well illustrated at the World's Columbian Exposition by a number of large views of the rolling stock of the New South Wales Government Railways. The passenger cars included compartment and "American" cars, and both English and Pullman sleeping cars, all carried on trucks, the Pullman vestibuled cars having six-wheel trucks. Short four-wheel sheep cars weigh 14,500 lbs. and carry 100 sheep, while the American type of cars, with diamond trucks, weigh 31,750 lbs. and carry 250 sheep. Many of the freight cars are carried on diamond trucks and closely resemble American practice, while some of them have iron frames. Flat, box and gondola cars, with tubular frames, are also used to some extent. The engines include mogul and ten-wheel types, of English construction, and there was a view of a suburban train of six "American" cars, with seating capacity for 360 passengers.

Specifications for creosote oil for the Great Northern Ry., Ireland, require it to be of the best quality, distilled from coal tar, and free from coal tar or other impurities. It must leave a density or specific gravity as near to 10.50 as possible, the range being from 10.35 to 10.55, water being 10 and the temperature being 60° F. It must be completely fluid at 100° F. and must not deposit crystals of naphthaline, paranaphthaline or other substances when subjected to a temperature of 40° F. It must yield to a solution of caustic potash not less than 8% of crude carbolic and other coal tar acids. On trial by distillation only one-fourth is to distill or pass over at a temperature of 600° F., and this fourth must be heavier than water.

The 18.94-knot average speed of the protected cruiser "Marblehead" over a 72-mile course, on Dec. 7, has been reduced to 18.44 knots by the government trial board. The reduction is due to tidal allowances as reported by the six government stakeboats. The "Marblehead" is a 2,000-ton ship, with a contract requirement of 5,400 I. HP. and a contract speed of 17 knots. At $25,000 premium for each quarter-knot above contract requirements she will thus earn $150,000 for her builders, the City Point Works, of Boston. The builders claim a new trial, but this question is still undetermined.

The Michigan farmers have put themselves upon record, at the late meeting of the Grange at Lansing, as opposed to the state and county road system, for the reason that "the farmers must bear the expense, while bicyclists and pleasure-riding citizens will reap the larger benefits." It is evident that the farmers of that state need some further education as to the real purpose of any well-considered movement in the direction of good roads and the methods of obtaining them. The farmers by no means "pay all the expenses." Careful statistics gathered in Massachusetts show that the cities and larger towns will there pay 67% of the cost of improvement, and while the proportion would probably not be so great in Michigan, the farmers will find the load more evenly distributed than they seem to think.

The Sault Ste. Marie Canal report, sent to Washington on Dec. 8, shows that in the year 1893, 9,840,754 net tons, registered, passed through the canal, a decrease of 707,440 tons as compared with 1892. The freight tonnage passed was 10,706,572 net tons, a decrease of 417,761 tons from 1892. The iron ore tonnage shows a decrease of 886,576 tons from 1892. The number of steamers that passed through in 1893 was 8,879; sail, 2,955, and unregistered craft, 674. The canal was open for navigation 219 days in 1893 and 233 days in 1892.

The Kintai bridge over the Nishiki River at Iwakun, Japan, is a wooden structure with five arches, the total length being 512 ft. The three central arches have 16-ft. rise, and the side arches 10 ft. The width of bridge is 16 ft. 4 ins. The piers are of ashlar masonry, and the river bottom is paved with three layers of large stones. The arches have five wooden girders composed of separate pieces, tied and pinned together, the girders varying in depth from the haunch to the crown. The floor planks are laid directly on the girders, and over the haunches these planks overlap so as to form steps. The side arches are supported by five trestle bents each, without longitudinal bracing, and the caps are boxed out for the girders. The bridge has been rebuilt several times, but the same style has always been maintained, but it is now to be replaced by iron through truss spans of 128 ft. c. to c. of end pins. The trusses are to be 20 ft. high, 16 ft. apart, with 16-ft. panel lengths. The live load is taken at 100 lbs. per sq. ft., dead load at 5,750 lbs. per panel, wind pressure 50 lbs. per sq. ft. The plans were exhibited at the World's Columbian Exposition.

The Abt rack rail system has been employed on the Ullswin Railway, in Japan. This railway has been built as a link between the northwest and southeast coast lines, and is situated on the east slope of the central range of mountains which form the backbone of the main island. The ascent is very difficult, and the line has to rise 1,800 ft. in five miles. The Abt system was therefore adopted, and the line was completed in the spring of 1893. It is of 3 ft. 6 ins. gage, with T-rails, secured by T-head bolts and clamps to Vautherin steel ties 7 ft. 2½ ins. long, weighing 106.11 lbs. each, and spaced 2 ft. 10⅝ ins. c. to c. There are three rack bars, carried in cast iron chairs bolted to the ties. The rails are spliced with six bolt angle bars. The line is seven miles long, with 26 tunnels, and five miles are laid with the rack rail, the grade being 6.66%, with short pieces of level at passing places.

WEATHER TABLE FOR NOVEMBER, 1893. [Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature, (Deg. Fahr.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation—rain and melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	32.8	60	2	58	8.6	36	N	1.98	1.06	10
	Portland, Me.	38.5	58	15	43	7.6	36	E	1.83	1.02	6
	New York, N. Y.	41.2	64	28	36	10.8	41	SE	3.71	1.50	9
	Pittsburg, Pa.	41.6	68	16	52	7.2	28	W	1.46	0.61	8
	Chicago, Ill.	36.0	67	4	63	17.6	51	SW	2.45	0.91	7
	Omaha, Neb.	36.8	72	0	72	7.9	30	NW	0.43	0.32	5
	St. Paul, Minn.	30.0	74	−10	84	8.5	29	NW	0.81	0.56	6
	Duluth, Minn.	28.6	61	− 7	68	5.1	30	NW	0.76	0.46	4
	Bismarck, N. Dak.	26.1	67	−15	82	11.0	44	NW	0.24	0.05	8
	Average	35.0	65	3+	62	9.4	36	NW	1.52	0.72	7
Southern Cities.	Washington, D. C.	43.6	66	21	45	6.7	28	NW	4.30	2.30	11
	Louisville, Ky.	44 4	72	12	60	8.7	32	SW	3.22	1.14	6
	St. Louis, Mo.	44.1	73	15	58	11.0	36	NW	1.36	1.05	4
	Savannah, Ga.	57.8	80	31	49	8.1	32	NW	2.31	1.69	8
	Jacksonville, Fla.	62.0	84	32	52	6.7	31	SE	1.76	0.94	7
	Chattanooga, Tenn.	50.6	76	22	54	6.8	26	S W	1.91	0.97	5
	New Orleans, La.	60.3	80	30	44	7.7	36	SE	6.24	3.35	9
	Memphis, Tenn.	50.0	76	24	52	7.2	33	SE	3.48	1.48	6
	Palestine, Tex.	55.3	84	28	56	6.7	24	SW	4.94	1.92	12
	Kansas City, Mo.	41.0	75	14	61	8.7	36	SW	1..8	0.55	3
	Average	56.6	85	26	59	8.7	35	SW	3.42	1.61	8
Western Cities.	Helena, Mont.	31.0	63	12	75	7.2	40	SW	1.44	0.53	11
	Port Angeles, Wash.	39.6	52	26	26	5.4	30	NE	7.52	1.68	21
	San Francisco, Cal.	55.6	74	44	30	7.7	47	NW	4.18	1.69	13
	Salt Lake City, Utah.	39 4	64	13	51	5 2	35	NW	1.18	0.62	10
	Santa Fé, N. Mex.	38.4	59	19	40	6.4	29	NW	0.29	0.21	3
	Denver, Colo.	39.0	71	8	63	5.3	57	NW	6.55	0.16	6
	Yuma, Ariz.	60.0	86	32	54	5.7	56	NW	0.19	0.19	1
	Average	33.7	52	14	38	4.7	28	NW	1.71	0.53	7

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & LEHIGH.—Surveys have been made for an extension from Taylor's Trestle to Dallastown, Pa., a distance of about two miles, and it is reported that the money has been secured for construction.

BAY OF QUINTE RY. & NAVIGATION CO.—The department of railways and canals, Ottawa, Ont., has approved the route for an extension of the Kingston, Napanee & Western Ry. between lakes Sydenham and Loughboro, according to reports. An extension from Harrowsmith to Lake Sydenham has recently been completed. Ch. Engr., M. J. Butler, Deseronto, Ont.

CANADIAN PACIFIC.—The city of Montreal has petitioned for an amendment to its charter authorizing it to borrow $1,000,000 to aid in the construction of the new station of this company in the East End, and the bridging of the level crossing in the West End of that city.

PENNSYLVANIA.—It is reported that this company will soon begin the construction of a short line from a point on the Southwest Pennsylvania branch to the coal and coke operations in Fayette county. This new line is to be called the Bates branch.——The grading of the Philadelphia & Delaware County R. R. will be completed this month, and tracklaying will be started at once. The road will be finished by July and will connect with the Pennsylvania at Fernwood and extend to Newtown Square, a distance of about 10 miles, all in Delaware county, Pa.——Press reports state that this company has surveyed two lines to Allentown, Pa. One runs from Perkiomen Junction, up Perkiomen Valley in a straight line to Allentown, and parallels the Perkiomen branch of the Reading. The other is from a point above Reading, through Kutztown, thence to Allentown. A third line has been surveyed from the Reading end of the route to Harrisburg, which, if the latter road was built, would give the Allentown people a direct route to the West.

WHEELING & LAKE ERIE.—This railway is being extended from Burlington, O., to Bellaire, a distance of eight miles. It is stated that the road will be built upon piles in the Ohio River for a large part of the distance, which work has been commenced at Burlington by Fitzmorris & Reardon, Fremont, O.

Projects and Surveys.

NOVA SCOTIA SOUTHERN.—This company proposes to build a railway from New Germany, on the Nova Scotia Central, to Sand Point, in Shelburne, for which a provincial subsidy of $3,200 a mile is asked; also a branch from Indian Gardens, with an extension from New Germany to a point near Halifax. Pres., R. G. Hervey, Halifax, N. S.

WISCASSET & QUEBEC.—The stock for this proposed railway in Maine is about all taken and work on the repair shops will be commenced at once. About 200 freight cars and other equipment will be constructed this winter and the main line of the road between Wiscasset and Burnham, 50 miles, as soon as the weather will permit. The work will be awarded in five-mile sections, according to reports. Pres., Geo. H. Crosby, Albion, Me.

Southern—Projects and Surveys.

ELKTON & SOUTHERN.—Press reports state that a corps of Baltimore & Ohio engineers is surveying a route for this proposed railway, referred to last week. Dr. Howard Bratton, Elkton (?), Md., has been elected treasurer of the executive committee.

KANAWHA VALLEY.—It is reported that this project will soon be revived by Senator J. N. Camden, of West Virginia. The line is proposed from Parkersburg, W. Va., up Little Kanawha River, through Elizabeth, Grantsville and Glenville to Burnsville, a distance of about 120 miles. Ch. Engr., Thos. Pettigrew, Parkersburg, W. Va.

PINEVILLE, MOUNT PLEASANT, ELKHORN & BIG STONE GAP.—This railway is projected from Pineville, Ky., through southeastern Kentucky to Big Stone Gap, Va., about 75 miles. Thomas F. Hargis, Pres. Commonwealth Land & Lumber Co., is reported

as stating that bonds have been issued and stock taken for constructing the first section of the road.

Northwest—Existing Roads.

BURLINGTON & MISSOURI RIVER.—Press reports from Omaha state that a contract for 400,000 ties is expected to be filled by Jan. 1. These ties are being secured on Tongue River in the mountains north of Sheridan, Wyo., and most of the number will be used in replacing old ties along the line.

ITASCA LUMBER CO.—This company has constructed a railway from near Minneapolis to Bow String Lake, a distance of about 25 miles, according to reports, the ultimate terminus of the road to be on the state boundary line about 25 miles farther on. A connection is made with the Duluth & Winnipeg, the terminus of which is now at Deer River. Pres., John P. Sims, Minneapolis.

Projects and Surveys.

WISCONSIN & MICHIGAN.—A press report from Menominee, Mich., states that this railway, which is designed to run from that city north to a connection with the Minneapolis, St. Paul & Sault Ste. Marie, at a point four miles west of Hermansville, is now an assured fact. John Bagley, Chicago, the chief promoter of the enterprise, contracted for several hundred thousand ties last week to be used in the construction of the road. Several miles of steel rails have also been bought and everything is ready for an early start in the spring. The new road will pass through Marinette, Wis., up the Wisconsin side of the river, and will then cross over into Michigan and head due north. The preliminary survey was completed some weeks ago. The new line will be built for a logging, freight and passenger business. The company was incorporated in October, as stated in our issue of Oct. 26.

Southwest—Existing Roads.

GULF, BEAUMONT & KANSAS CITY.—An incorporator of this company is reported as stating that the road has been constructed from Beaumont, Tex., to beyond Village Creek, a distance of 20 miles. The surveyors are now in the field under L. J. Kopke, Ch. Engr., running preliminary lines with a view to selecting a route to be followed in building into Jasper county. After the route is determined on, the party will continue the survey to the north line of Jasper county. John H. Kirby, Vice-Pres., is now in the East making financial arrangements for the continuation of the construction of the road. It will extend to the north line of Jasper county, where fine quarries are located. The rock there is said to be of excellent quality and in the greatest quantity, and it can be used for jetty construction at both Galveston and Sabine Pass. What has been done on the road is first-class in every respect. A spur track has been extended out to the river, about three miles above Beaumont, where logs will be dumped in the river instead of hauling them down to town. The road is intended to be a link in a through line from Sabine Pass to Kansas City.

KANSAS CITY, PITTSBURG & GULF.—The construction of this road is about completed to Siloam Springs, Ark., and it is expected that trains will be run from Kansas City to that place, 231 miles, this week. The present terminus of the road is at Sulphur Springs, Ark., and the extension is through Benton county, Ark., for about 25 miles to Siloam Springs. During the present year the company has added nearly 100 miles of road to its operated mileage in Kansas, Missouri and Arkansas. It is proposed to extend the line next year south of the present terminus toward Fort Smith, Ark., about 80 miles. Bernard Corrigan, Kansas City, is the contractor for all the new work.

LOUISIANA, ARKANSAS & MISSOURI.—About 15 miles of this railway have been graded this year, according to reports, upon which the track will be laid before spring, and negotiations are now being made which are expected to result in completing the line to Delhi, La., before the close of next season. This would give the company about 85 miles of road through the best timbered portion of Louisiana and would make a valuable feeder for the Iron Mountain system, with which it connects at Trippe, Ark. Gen. Man., H. A. Fisher, St. Louis.

Projects and Surveys.

KANSAS CITY & NEW ORLEANS.—This company was incorporated in June, 1892, to build about 120 miles of railway. Press reports state that W. A. Desborough, Pres., will return to Texas Jan. 10 and make his headquarters at Wolfe City, where he will locate a temporary office of this railway company, and that arrangements are being made with English capitalists to construct 18 miles of the railway, to Dalby Springs.

LAKE SUPERIOR, SOUTHWESTERN & GULF.—The incorporation of this company was noted last week to bring under one management a continuous railway between Duluth, Minn., and deep water on the Gulf of Mexico. J. M. Miller, Secy., Springfield, Mo., is reported as stating that the construction of the 200 miles south from Aurora, Mo., to Little Rock, Ark., will be commenced within 60 days. From various facts made public concerning the new company it is thought that the Goulds are interested in the southern part of the project and the Chicago, Rock Island & Pacific in the Iowa and Minnesota portion.

NORTH ARKANSAS.—Incorporated in Arkansas to build a railway from the main line of the Iron Mountain in Clay county through Clay and Randolph counties to a point on Current River, a distance of 16 miles; capital stock, $125,000; directors, G. B. Oliver and Z. T. Daniels, Corning, Ark.; D. W. Reynolds, Reynos, Ark.; H. M. Hill and Franklin Duff, St. Louis.

YOAKUM & VELASCO.—A press report from Edna, Tex., states as follows: A plan is being discussed by certain wealthy real estate owners to secure a railway from Yoakum to Velasco, touching at the head of Caranchua Bay, where a town will be laid out, thence to Matagorda and other intermediate points as are or may become interested. After the project has been thoroughly discussed among themselves and they ascertain what sum in donations can be raised, and if the encouragement is sufficient, correspondence will be opened with the Aransas Pass authorities. The construction of such a line would open up to actual settlers the finest agricultural country in Southern Texas, and would bring Waco and North Texas generally in direct communication with a deep water seaport.

Rocky Mt. and Pacific—Projects and Surveys.

MONTANA MIDLAND.—It is reported that this company has been incorporated by Gutler Whitney, W. J. Fuens, A. G. Lombard, J. D. Wilson and Milton Gunn, Helena, Mont.; capital stock, $2,000,000.

PAYETTE VALLEY & NORTHERN.—This company has been incorporated in Idaho largely by those interested in the Seattle, Boise & Salt Lake R. R. Co., which had awarded a contract for the construction of a railway from Payette, Idaho, to the Seven Devils mining district, in Washington county, when the financial panic came and stopped matters. It is proposed to build this line as soon as the necessary funds can be secured. The plans of the incorporators contemplate about 400 miles of road, and the recent visit of W. F. Merrill, Gen. Man. Chicago, Burlington & Quincy, to that vicinity has caused rumors that the scheme is being backed by that road. The directors are J. W. Bates, Wm. Ireton and M. L. Sproat, Payette, Idaho; F. R. Coffin and Jas. A. Pinney, Boise City, Idaho. Mr. Bates has taken 3,988 of the 4,000 shares subscribed.

WASHINGTON.—A press report from Zillah, Wash., states that H. K. Owens has a party of engineers running preliminary lines for a projected railway through the Sunnyside country.

Foreign.

MEXICAN INTERNATIONAL.—A press report from Durango, Mex., states that this company has decided to extend its line from that city to the city of Mexico, and not to the port of Mazatlan, on the Pacific coast, as was intended. The preliminary survey to the city of Mexico was run some time ago, and has been approved by the government. The extension from Torreon to Durango, which was completed about a year ago, has so far been a losing venture, according to reports, owing to the light freight and passenger business. By building to the city of Mexico an outlet will be secured which will put the road on a paying basis. The construction work on the extension will begin next month. Pres., C. P. Huntington, New York; Gen. Man., L. M. Johnson, Ciudad Porfirio Diaz, Mex.

INTEROCEANIC.—Funds necessary to complete this road between the city of Mexico and Acapulco, a deep water harbor on the Pacific coast, have been subscribed in London, according to a report from the city of Mexico. It is stated that a large force will be put at work upon the construction of the road in February. Gen. Man. and Ch. Engr., Charles Clegg, Mexico City, Mex.

STREET RAILWAYS.

BOSTON, MASS.—The "Herald" states as follows: There is a project on foot which, if brought to a successful consummation, will result before many months in Boston being united with Brockton, Whitman, Rockland, Randolph and Nantasket Beach by means of an electric railway. The plan now proposed is this: The Rockland & Abington St. R. R. Co., whose line extends through Whitman, Abington, North Abington to Columbian square in South Weymouth, proposes to extend its tracks from the last-named point to Commercial St. in East Weymouth, and thence to the Hingham line. Here it is proposed to form a connection with a new line which is to be built to Downer Landing and Nantasket Beach by Boston parties.

The Quincy Electric St. Ry. Co. will, early in the spring, extend its tracks from North Weymouth to Commercial St., East Weymouth, where it will connect with the Rockland & Abington Electric St. Ry., should it succeed in securing its franchise, as it undoubtedly will. The Quincy company has already secured its franchise for the extension. The Brockton Electric St. Ry. Co. has already two terminals, one at Randolph and another at Holbrook. Another company, known as the Braintree, Holbrook & Randolph Electric Ry., has also secured a franchise to build a road from Randolph and Holbrook through Braintree to the Quincy line, which is nearly completed. It is said that the Quincy company will extend its tracks from South Quincy to the terminus of the Braintree, Holbrook & Randolph road. This will make a complete connection between the points described, and all the towns will have a complete belt line.

HOLYOKE, MASS.—The street railway will be extended to the Northampton line next summer probably, and either next summer or in 1895 the line will be extended to Mount Tom, a distance of two miles, according to reports. The street railway company is said to have made extensive purchases of land on the mountain, where it is proposed to lay out pleasure grounds.

LOWELL, MASS.—The Lowell & Suburban St. Ry. Co. has petitioned the general court for authority to construct an electric railway in the highways of the towns of Westford, Bedford, Burlington and Wilmington, in the county of Middlesex, and the town of Andover, in the county of Essex.

NORTHAMPTON, MASS.—Surveys for the proposed electric railway to Williamsburg have been completed by W. W. Strong, and a line to Easthampton will soon be surveyed.

WEYMOUTH, MASS.—The Quincy & Boston St. Ry. Co. has petitioned the selectmen for an extension of time from Jan. 30 to June 27 for the completion of its road to Jackson Square, East Weymouth. It already has until June 27 to build the line from Old Spain to the corner of North and Commercial Sts.

HARTFORD, CONN.—The council has granted to the Hartford St. Ry. Co. a franchise to use the trolley system on the Lafayette, Parkville and Asylum Sts. and Farmington Ave. lines.

NEW HAVEN, CONN.—The incorporators of the West Shore Electric R. R. Co. have made arrangements to build a line from the terminus of the Winchester Ave. road at Savin Rock to Merwin's Point, a distance of about 3½ miles. The incorporators are J. D. Dewell, Henry Sutton, I. A. Kelsey, C. K. Bush and W. W. Ward; capital stock, $50,000. It is expected that the road will be in operation by June 1.

LIBERTY, N. Y.—It is reported that an electric railway will be built from this place by way of Stevensville to White Lake, with a line from Stevensville to Jeffersonville, passing through White Sulphur Springs and Youngsville. The principal power station will be at Stevensville, and it is hoped to have the entire 20 miles constructed by next July. S. P. Kellogg and J. C. Citrehugh, Elizabeth, N. J., are said to be interested.

NEW YORK, N. Y.—The agreement of consolidation between the Houston, West St. & Pavonia Ferry R. R. Co., the Broadway R. R. Co. and the South Ferry R. R. Co. has been filed in the office of county clerk. The name of the new company is to be the Metropolitan St. Ry. Co.; capital stock, $8,200,000; Pres., H. H. Vreeland; 1st Vice-Pres., D. B. Hasbrouck; 2d Vice-Pres., H. A. Robinson; Treas., H. S. Beattie; Secy., Chas. E. Warren.

NIAGARA FALLS, N. Y.—Press reports state that the Niagara Falls & Buffalo Electric R. R. will surely be built. W. Caryl Ely, Pres., has returned from New York and will go ahead with the work, and before Aug. 1, 1894, Niagara Falls people will be slipping off their electric cars on Main St. at Buffalo. The road will be constructed along a boulevard. Heavy T rails will be used and a 35-mile rate of speed maintained in the country districts.

SANBORN, N. Y.—It is reported that the construction of the projected electric railway to Tonawanda has been commenced. The road will be about six miles in length and will make a short cut to Buffalo for residents of this place. L. F. W. Arend, Buffalo, and Lee R. Sanborn, of this place, are interested.

BRIDGETON, N. J.—The West Side Ry. Co., capital stock $20,000, and the Bridgeton, Cedarville & Port Norris Ry. Co., capital stock $70,000, have been incorporated by Osgood Welsh, New York; W. Welsh, Jr., R. W. Clay, J. P. Newbold, Philadelphia; C. R. Newbold, J. Smalley, T. N. Harris, W. O. Garrison, W. H. Bacon, Bridgeton.

NEW BRUNSWICK, N. J.—The street railway company has petitioned for permission to change its motive power from horse to electricity, as stated last week. The company is reported as proposing to extend its lines through the city, taking in the downtown business section, and also beyond the limits of the city in the direction of Plainfield, Rahway, Somerville and South Amboy.

PAULSBORO, N. J.—The Camden, Gloucester & Woodbury Ry. Co. is considering an extension of its line to this place.

MUNCIE, PA.—R. R. Noble, D. B. Dykins and G. L. Painter are among those reported as interested in a proposed electric railway from the Philadelphia & Reading station along the main highway to Picture Rocks, the road to be constructed in the spring.

PHOENIXVILLE, PA.—The Schuylkill Valley Illuminating Co. has secured a franchise for its proposed electric railway through this place. A local paper states that the line will commence at Valley Forge and come by way of Williams Corner and Corner Stores to this place, entering near the knoll and coming into the heart of the town by way of Main St., to the corner of Bridge and Main, then along Bridge St. to Gay, across the Gay St. bridge, then up over the hill on Franklin Ave., on to Spring City and thence to Royersford. A branch is also projected from a point on the hill in Mount Clare across the river and along Bridge St. to Harveyville, thus making a complete system along the principal streets to the outer extremities of the town. If the necessary franchises are secured it is expected that the construction of the road will be commenced in the spring.

PITSBURG, PA.—The Glenwood & Dravosburg Electric St. Ry. Co. has been incorporated; capital stock, $27,000; Pres., Herman Laub.

ABERDEEN, MD.—The U. S. Automatic Service Co., Worcester, Mass., has been granted a franchise for an electric railway and an electric light and power plant. The citizens have agreed to subscribe $30,000 to the capital stock of the railway company for the purpose of building a branch road from this place to Glenville, where it would intersect the main line, and from thence to the Susquehanna paper mills. A corps of engineers was in town last week surveying the route for the proposed branch.

BENWOOD, W. VA.—The Moundsville & Benwood Ry. Co. has been incorporated to build an electric railway from this place to Moundsville, by way of McMechen and Glendale, a distance of 16 miles. It is stated that the money to build the road has been subscribed and that as soon as the necessary franchises and rights of way are secured arrangements will be made for the construction. Ben Wilson, Clarksburg, is interested.

COLUMBIA, S. C.—The Columbia St. Electric Ry. & Power Co. has petitioned for a franchise to extend its railway on five streets.

CINCINNATI, O.—The Consolidated St. R. R. Co. has been granted a permit to erect a power house at the east end of Straight St. The building is estimated to cost $7,000.

FREMONT, O.—The council has passed an ordinance granting the Fremont St. Ry. Co. the privilege of equipping its lines with electricity. The company will begin work immediately, according to reports.

TIFFIN, O.—A press report states that within a few days the papers for the incorporation of the Tiffin & Fostoria Consolidated Electric Ry. Co. will be forwarded to the secretary of state. It has been decided to increase the capital stock from $300,000 to $400,000 in order to construct a 15-mile branch from Tiffin to Sycamore, by way of Melmore, and it is probable that a line will be extended from Melmore to Bucyrus and from Sycamore to Upper Sandusky next season. The company will continue its work on the Tiffin and Fostoria line, and announces that electric cars will be running between the two cities early next spring, as stated in our issue of Dec. 7.

ELWOOD, IND.—Plans are being considered for an electric railway to Alexandria and thence to Frankton, a distance of 18 miles.

FORT HOWARD, WIS.—Edward Morton, New York, has petitioned for a franchise for a street railway.

SIOUX CITY, IA.—Press reports state that the Consolidation Co. has been organized by John Pierce, A. E. Pierce, Peter and Chrys Moller and H. A. Johns. It has absorbed the Sioux City Cable Ry. and expects to consolidate all the street railway systems in the city—the Sioux City St. Ry., the Rapid Transit lines, Riverside Electric and Sioux City & Leeds Electric—into one electric system 45 miles in length. The company is capitalized at $1,000,000, with offices in New York and Sioux City.

FORT SMITH, ARK.—The Fort Smith & Van Buren Ry. Co. has been incorporated with a capital stock of $200,000 to construct an electric railway four miles long, uniting the cities of Fort Smith and Van Buren, on opposite sides of the Arkansas River, and will cross on a railway and wagon bridge to be built across

the river. Pres. and chief stockholder, L. N. Beatty, Lima, O.; J. L. Rea, R. S. Hynes, Van Buren; J. H. Walsh, Fort Smith; W. C. Lement, Bucyrus, O.

PORTLAND, ORE.—A letter to the editor of the "Oregonian" gives reasons for believing that the Southern Pacific R. R. Co. is planning the immediate construction of an electric railway from this city by way of Oregon City, up the Tualatin River into the Nehalem basin and thence to Astoria. It is stated that the company's chief attorney has recently spent several days investigating the title and status of the Steels' electric line to Oregon City, and that surveys have been made for an extension of the Portland General Electric Co.'s line at Oregon City up the Tualatin River to Hillsboro.

WINDSOR, ONT.—An electric railway will soon be built to Amherstburg, according to reports.

ELEVATED RAILWAYS.

ST. LOUIS, MO.—The Unicycle R. R. Co. has petitioned for a franchise for an elevated railway in this city. The company agrees to carry only passengers and parcels, and to give the city $3,000 per year for the first 10 years and $5,000 per year thereafter, the franchise to be for 50 years.

HIGHWAYS.

NEW YORK.—The citizens of Hamburg are interested in a proposed state road from Buffalo to that place; estimated cost, $40,000 to $50,000.

COLORADO.—The contract for the Dolores-Rico wagon road, 45 miles long, has been awarded by the state engineer to J. A. McIntire & Co., Denver, at $9,757, the other bids being as follows: J. S. King and W. J. Prisk, $11,495; C. Johnson, $9,925; James Egan, $12,500; Wright & Barker, $10,890; S. C. Berthelson, $10,500; Campbell & Wood, $12,450; H. F. Morgan, $15,900; Mancos Lumber Co., $15,065; James H. Treece, $11,500; James H. Barry, $10,400.

BRIDGES AND TUNNELS.

BATH, N. Y.—The village is reported as considering a proposition to issue $50,000 of bonds for a bridge.

NEW YORK, N. Y.—Plans have been prepared for a viaduct half a mile in length to connect Willis Ave., by means of a bridge across the Harlem River, with First Ave. at 125th St.; estimated cost, $2,000,000.——The commissioners of the state reservation at Niagara have approved plans for an iron bridge to Luna Island. Pres., Andrew H. Green, 214 Broadway.

CHESTER, PA.—The grand jury has visited the site of the proposed bridge across Chester Creek at Fifth St., and it is understood that a new bridge there will be recommended.

PITTSBURG, PA.—The Mendelsohn & Glassport Bridge Co. has been incorporated to construct a bridge across the Monongahela River; capital stock, $5,000; Ralph Bagaley, D. C. Corwin, W. C. King, Pittsburg; F. M. Hoffstot, Allegheny City; D. B. Blackburn, Jefferson.

TUSCARAWAS, O.—A five-span wooden bridge crossing the Tuscarawas River at this place was burned Dec. 15. It will cost $30,000 to $40,000 to replace it, according to reports.

LANSING, MICH.—The city clerk has been instructed to offer $100 for the best plans and specifications for a steel or stone bridge over Grand River at Michigan Ave.; length, 210 ft.; width, 116 ft.; capacity, 100 lbs. per sq. ft.

BEAUMONT, TEX.—Press reports state that the Southern Pacific R. R. Co. will build a new bridge over the Natchez River at this place.

OTTAWA, ONT.—A contract has been signed between the city of Ottawa and the Pontiac & Pacific Junction Ry. Co. for the construction of a railway and passenger bridge over the Ottawa River.

PETERSBOROUGH, ONT.—The town engineer has been instructed to prepare plans for a new bridge to span the river a short distance from the old railway bridge.

CHARLOTTETOWN, P. E. I.—Bids are asked until Jan. 9 for a steel bridge across Martin's Creek, near Eldore. J. W. Morrison, Secy. Pub. Wks.

WATER-WORKS.

ESSEX JUNCTION, VT.—F. P. Sawyer, Vil. Clk., writes us that the village has not yet decided whether to put in works or to secure an engine for fire protection. Water can be pumped from a river a quarter of a mile distant. A committee is investigating the question.

BROCKTON, MASS.—The commissioners will receive bids until Jan. 5 for 1,900 tons 6 to 24-in. cast iron pipe.

BROOKFIELD, MASS.—A reservoir near the Moulton factory is proposed.

GLOUCESTER, MASS.—W. Frank Parsons and I. A. F. Steele are members of a commission appointed to revise the city charter so as to permit the city to establish independent works.

HOLYOKE, MASS.—The proposed gravity supply from Granville, referred to in our last issues, is 11¼ miles distant from the city.

MEDFORD, MASS.—The aldermen have appropriated $10,000 for increasing the supply and erecting a pumping station at Wright's Pond. The city treasurer has been authorized to issue $100,000 of 25-year 4% water bonds.

ORANGE, MASS.—A town meeting was called for Dec. 19 to consider an additional loan of $15,000 to pay for building the works.

SPENCER, MASS.—Nathan E. Craig, Tn. Engr., has been instructed to procure advice concerning the construction and location of a proposed stand-pipe.

STONEHAM, MASS.—The citizens have unanimously voted to unite with the town of Wakefield in the proposed purchase of the plant of the Wakefield Water Co., which now supplies the two places.

UXBRIDGE, MASS.—The legislature will be petitioned for authority to enlarge and improve the works, at a cost not to exceed $80,000.

PAWTUCKET, R. I.—The commissioners have asked for $35,000 for extensions next year.

BROOKLYN, N. Y.—The aldermen have authorized an issue of bonds for $685,000 for additions to the pumping stations at Ridgewood and Milburn.

CHERRY CREEK, N. Y.—It is reported that the citizens are discussing the question of works.

GLENS FALLS, N. Y.—Water bonds for $80,000 will probably be issued next summer for a new main from the Dixon Brook to the reservoirs. The work was authorized last year.

NEW WOODSTOCK, N. Y.—The necessary funds for works have been secured, according to reports.

IRVINGTON, N. J.—The Irvington Water Co. has been granted an extension of six months of time for completing the works. It is stated that the construction will now be hastened as rapidly as possible.

LORRAINE, N. J.—The Lorraine Water Co. has awarded the contract for works to Harding Johnson, New York. The company has contracted with the Union Water Co. for a supply for ten years.

WILDWOOD, N. J.—Works and an electric light plant will be put in, according to reports.

CHARTIERS, MANSFIELD, ROBINSON AND SCOTT, PA.—The Chartiers Water Co., Mansfield Borough Water Co., Robinson Township Water Co. and Scott Township Water Co. have been incorporated to secure supplies for the respective places; capital stock of each, $5,000; Treas., Martin Prenter, 5,169 Woodworth Ave., Pittsburg; other directors, M. W. Watson, J. H. Dalzell, J. W. Scully, Allegheny; T. B. Aterburg, Pittsburg.

M'KEESPORT, PA.—Robt. Taylor, councilman, has a scheme for securing a supply from the Monongahela River.

M'KEE'S ROCKS, PA.—The borough authorities are reported as about to put in works, the present service not being satisfactory.

NEW CASTLE, PA.—The New Castle Water Co. contemplates important improvements, including an additional pump, a new supply main and a reservoir.

HIGHLANDTOWN, MD.—Works are proposed for this place and Canton; estimated cost, $200,000. J. F. Wiessner and Frank Kraft are interested.

PORT DEPOSIT, MD.—Jacob Tome is reported as having been granted a franchise.

NORTH DANVILLE, VA.—The council is negotiating with the Danville council for a supply.

BENWOOD, W. VA.—Col. Benj. Wilson, Clarksburg, and others have petitioned for a franchise.

BERKLEY SPRINGS, W. VA.—S. S. Buzzerd, Recorder, writes us that the bonds for $10,000 recently voted are to aid the company to complete the works, now nearly completed by Jas. Lockhead, contractor, Washington, D. C.

MOUNDSVILLE, W. VA.—Surveys for the proposed works, noted last week, are being made by J. F. Busby & Bro.

WESTON, W. VA.—Municipal works and an electric light plant are reported as being discussed.

ELBERTON, GA.—A bill has been presented in the legislature authorizing the question of works and an electric light plant to be submitted to a vote of the citizens.

FORSYTH, GA.—It is reported that the proposed works will be put in soon.

BARTOW, FLA.—Bonds will be issued for works, according to reports.

MERIDIAN, MISS.—A petition is being circulated looking to the purchase of the works.

CYNTHIANA, KY.—Bids are asked until Dec. 28 for works, including 520 tons cast iron pipe, 22 × 100-ft. stand-pipe and two 1,000,000-gallon pumping engines. L. S. Williams, Cy. Clk.

MADISONVILLE, KY.—The construction of works is being urged.

NEWPORT, KY.—A new pumping engine will soon be needed.

CANTON, O.—The city is planning important improvements and extensions.

LOCKLAND, O.—The citizens have voted, 272 to 83, to issue bonds for $20,000 for works.

WEST CLEVELAND, O.—It is stated that a new reservoir is wanted.

BLOOMINGTON, IND.—Robt. C. Greeves, Cy. Clk., writes us concerning the report published last week that the franchise of the company had been declared forfeited, that the cause was the failure of the company to complete the works on time. Some work has been done since then.

CORYDON, IND.—Steps are being taken to secure works according to the plans of ex-Cy. Engr. Coolman, of New Albany, the supply to be from a small lake in the northern limits of the town.

FORT WAYNE, IND.—The council proposes extensions which will employ several hundred men for several weeks, according to reports.

HAUGHVILLE, IND.—The trustees are reported to have voted to put in works.

JOLIET, ILL.—It is proposed to issue bonds for surveys and investigations for a new supply.

URBANA, ILL.—The mayor has recommended that the franchise of the water company be extended only on condition that the mains be extended and a stand-pipe erected for fire protection.

ROCKFORD, ILL.—Several propositions are being considered for increasing the supply.

LA CROSSE, WIS.—The city engineer has been directed to prepare plans for a pumping station on the North Side.——Bonds for $25,000 have been voted for securing better fire protection.

MAZOMANIE, WIS.—H. R. Learnard, Clk., writes us that the contract for 10 driven wells, 3,000 ft. new mains, etc., has been awarded to Fairbanks, Morse & Co., Chicago.

ONALASKA, WIS.—At a meeting of the taxpayers recently a resolution was passed unanimously requesting the council to call an extra election to vote on an issue of bonds for works.

HIBBING, MINN.—It is proposed to grant a franchise, the village to have the right to purchase the plant in five years.

MANKATO, MINN.—The contract for a pumping engine has been awarded to the Knowles Pump Co., at $1,750. The bids were published in our issue of Dec. 7.

MINNEAPOLIS, MINN.—The contract for constructing the intake pipe for the North Side pumping station has been awarded to J. J. Gleason, at $7,800. The total bids were published Dec. 7.

PARK RAPIDS, MINN.—The village has sold $6,000 of 7% water bonds, and works will be put in at once, according to reports.

SHERBURN, MINN.—The citizens are reported as discussing works for fire protection.

SIOUX CITY, IA.—Press reports state as follows: A proposition from an eastern syndicate to take the city's water-works system for $1,500,000, the amount of the city's debt, and assume the bonds against it, has been submitted, but will undoubtedly be rejected by the council.

FORT LEAVENWORTH, KAN.—Works will be put in, the supply to be from wells in the Missouri River bottom and pumped to a reservoir.

BLOOMFIELD, NEB.—A petition has been signed by nearly every citizen, it is said, asking for an election to vote on an issue of bonds for works.

FULLERTON, NEB.—An election will soon be held to vote on an issue of bonds for works, according to reports.

GRAND ISLAND, NEB.—The council is planning to put in works.

HASTINGS, NEB.—A proposition to issue bonds for $10,000 for extending the mains will be voted upon in April.

SARATOGA, WYO.—The question of works is being discussed.

BUTTE CITY, MONT.—The Butte City Water Co. will issue $1,500,000 of bonds, which are expected to be sufficient to complete the improvements now under way. Work on the dam will be resumed about May 1. About $75,000 has been expended during the past year.

EL PASO, TEX.—J. A. Badger, Mayor, is investigating works in other cities. It is stated that the city will spend $200,000 for works. Works were built here in 1882 under a 25-year franchise.

LOCKHART, TEX.—It is reported that the city will soon have works.

CHANDLER, OKLA.—Material for proposed works is being delivered, according to reports.

PERRY, OKLA.—The council has granted a franchise to Delaney & Scott, Oklahoma City, the construction to be commenced within 30 days and completed in four months. The work includes six miles of mains, 80 hydrants and a stand-pipe and two pumps; estimated cost, $50,000.

HIGHLANDS, COLO.—A franchise has been granted to the Citizens Water Co. The Denver Water Co. already has a franchise and owns the works built here in 1887.

TRINIDAD, COLO.—Surveys have been made for a 50,000,000-gallon reservoir, which will probably be constructed in the spring.

NATIONAL CITY, CAL.—We are informed that the San Diego Sound & Town Co. is talking of extending its system.

SAN DIEGO, CAL.—The Mountain Water Co. has been incorporated with a capital stock of $5,000,000.

MONCTON, N. B.—At an election Dec. 11 a proposition to expropriate the works was carried by a large majority.

ARTESIAN WELLS.

HARRISON, S. DAK.—F. Le Cocq, Jr., Chn. Comm., informs us that Douglass county will award contracts for sinking and casing four artesian wells; estimated cost, $11,000 to $13,000.

HURON, S. DAK.—Capt. C. S. Fassett, state engineer of irrigation, has reported that 21 artesian wells have been put down since March 1, 1893, including the following: One each in Bon Homme, Douglas, Hughes, Beadle, Spink and Hutchinson counties; two each in Aurora and Hand counties; three each in Yankton and Brown counties. The work is done under the provisions of the state irrigation law, and all are to be used for irrigation purposes.

IRRIGATION.

LIMA, MONT.—The Helena "Independent" prints a description of the enterprise of the Lima Reservoir & Irrigation Co., from which we take the following: The work of building a dam across Red Rock Creek has been commenced where it passes through a narrow channel in Centennial Valley. A tunnel is also being run through the side of the mountain, by means of which water is to be taken from the reservoir. The dam will soon be completed, as also the necessary canal, so as to put water on some 80,000 acres of land lying below the dam and in the vicinity of the town of Lima. It is expected to ultimately carry water down to the vicinity of Dillon. The dam is to be 50 ft. high and 40 ft. wide on top, with an extreme length of 212 ft. of solid masonry, and joins the mountains on either side of the pass. It is expected to make a reservoir 30 to 40 miles long and about two miles in width. The tunnel is 7 ft. square, driven a distance of over 176 ft. through solid rock. The surface is completely plastered with the best Portland cement throughout its entire length, and has a capacity of 1,500 cu. ft. of water per second under a pressure of a 40-ft. dam. This tunnel can be enlarged when the needs of the lands below require greater supply of water. The main canals will commence at the dam, 12½ miles east of Lima, and at the head of the upper valley in which is situated the land to be watered, and extend below Lima a distance of 26 miles. There will be two main canals; one will require to be constructed throughout its entire length; for the other the channel of Red Rock Creek will be utilized, the water being reclaimed at such points as are found necessary. The permanent water right charges will be $10 an acre, and $1 an acre for annual water rental, which is less than the usual price for either.

LOVELAND, COLO.—The Denver "Republican" states that S. J. Gilmore and G. L. Anderson, Denver, have been in Loveland making final arrangements for letting the contract for building the People's reservoir, which will be built about a mile north of this place. The reservoir will make one of the largest in this part of the state. It will serve as a feeder mainly for the Larimer and Weld county canal. Owing to the accessibility there is a plan proposed also to use it as a pleasure resort, as well as for storage purposes. Work will be commenced on the reservoir as soon as the preliminary survey can be made.

SANTA FE, N. MEX.—The Mesilla Valley Irrigation Colony has been incorporated by N. E. Boyd, of Eng-

land; W. T. Thornton, Santa Fe; A. M. Loomis, E. V. Berrien, E. C. Roberts, P. E. Kern, J. L. Campbell, El Paso, Tex.; W. S. Hopewell, Hillsboro; P. Freudenthal and Henry Bowman, Las Cruces; capital stock, $250,000; principal places of business, at Las Cruces, El Paso, Albuquerque, Chicago and New York. Dr. Nathan E. Boyd has been at Las Cruces for four months looking into the resources of that region, and it is understood that this company has been organized with a view to introducing Eastern capital to carry it forward.

SAN BERNARDINO, CAL.—F. P. Morrison, Redlands, has been appointed receiver of the Bear Valley Irrigation Co., which has a capital stock of $4,000,000 and has heretofore paid 15% dividends. The company supplies Highland, North San Bernardino, Redlands, Alessandro, Moreno and Perris with water for irrigation, and has during the recent money stringency been attached for money due for work done and material furnished in extending its irrigation canals and pipe lines to new districts during the past summer.

YUMA, ARIZ.—The canal and irrigation pumping plant of the Colorado River Irrigating Co., of Arizona, has been purchased by Rollins & Sons, Denver, according to reports.

SEWERS.

PAWTUCKET, R. I.—The council has appropriated $26,300 for three sewers.

WINCHESTER, MASS.—It is reported that the commissioners have completed plans for a system estimated to cost $100,000.

SYRACUSE, N. Y.—The council has authorized a loan of $10,000 for 12 to 14-in. tile and brick sewer.

HOBOKEN, N. J.—Plans have been adopted for sewers to relieve the lowlands. The building of these sewers has been agitated for several years, and the city was authorized last winter to issue bonds for the construction. The main sewer will be of brick, 30 × 45 ins., and 42-in. cast iron pipe.

NEWARK, N. J.—Bids are asked until Dec. 27 for a 15-in. pipe sewer in Warren Place. Chas. Marsh, Supt. Wks.

PATERSON, N. J.—The clerk has been instructed to advertise for bids for a sewer in Lynn St.

TRENTON, N. J.—The 12 sewer commissioners have organized by electing J. N. Lindsay chairman and Geo. E. Fell secretary.

BRUSHTON, PA.—It is proposed to construct sewers in connection with the Pittsburg system, at an estimated cost of $12,000. The proposition to issue bonds for $60,000 for a system was recently defeated.

LANCASTER, PA.—The council is considering the borrowing of $300,000 for sewers and streets.

READING, PA.—An ordinance is being considered appropriating $50,000 for a sewage pumping station.

MACON, GA.—Plans have been adopted and bids will be asked at once for the proposed sewers, according to reports. About two years will be required to construct the system.

MERIDAN, MISS.—The committee has been instructed to ascertain the cost of right of way for the proposed system.

CLARKSVILLE, TENN.—A petition has been presented for a sewer in Franklin St.

CINCINNATI, O.—Plans are being made for a sewer in Carthage pike to drain Corryville, Clifton and Avondale; also for one in Boldface Creek to drain West Price Hill.

INDIANAPOLIS, IND.—The board of public works has received the following bids for a local sewer in Pennsylvania St.: A. Bruner, $2.30 per lin. ft.; Wm. Bossert, $1.98; Acme Paving & Contracting Co., $1.89; Gansberg & Roney, $1.89; Danie Foley, $1.85; R. P. Dunning, $1.67; E. P. Hanahan, $1.63; H. C. Roney, $1.57; T. T. Sheehan, $1.49, awarded the contract. Morton St.: A. Bruner, $5.95; Gansberg & Roney, $5.17; Wm. Bossert, $5.08; Daniel Foley, $4.75; T. Sheehan, $3.75; Acme Paving & Contracting Co., $3.67, awarded the contract. The contract for the White River main sewer, 9,593 ft., has been awarded to Wilding & Derheimer, Fort Wayne, at about $84,000.

WAUWATOSA, WIS.—O. E. Meyer, the patentee of the Meyer sewage disposal system in operation at the Miller brewery, Milwaukee, has offered to erect a plant for purifying the sewage from the county institutions at this place for $25,000, less $2,000 if contract is awarded so work can be done this winter.

WATERTOWN, WIS.—The contract for the main portion of the new system has been awarded to McCann & McLellan, Ashland, Wis., at $44,461, according to reports.

SPRINGFIELD, MO.—Ordinances have been passed for sewers in one district. G. W. Hackney, Cy. Clk.

DENVER, COLO.—Bonds for $30,000 have been sold for sewers.——The board of public works considers it necessary to place 440 flush tanks in old sewer districts.——An appropriation of $13,000 has been made for the sewer flushing department.

SEATTLE, WASH.—The council has voted to commence work upon three brick sewers, to cost about $50,000, as soon as the money from the sale of bonds has arrived.

FRUITVALE, CAL.—The question of incorporation is being discussed in order to issue bonds for sewers.

STREETS.

NEWTON, MASS.—The city treasurer has been authorized to borrow $5,400 for improving Mills St. and $2,500 for grading Needham St.——Bonds for $100,000 will be sold at once to commence the construction of the second section of the Central boulevard, this section extending through Newtonville and West Newton. The work will be commenced as soon as possible.

ERIE, PA.—Geo. Platt, Cy. Engr., informs us that resolutions have passed the council for 1.74 miles of paving. The resolutions declare the intention of the city to pave certain streets, and property owners have 60 days to decide the kind of pavement. The ordinances will then be passed for the improvements. Contracts will probably be awarded in February or March.

LANCASTER, PA.—The council is considering the borrowing of $300,000 for streets and sewers.

CINCINNATI, O.—The city has sold $170,752 of improvement bonds, some of which were sold at a premium of 3⅝%.

INDIANAPOLIS, IND.—The department of public works will receive bids until Dec. 27 for eight contracts for grading and graveling.

QUINCY, ILL.—Ordinances have been passed for paving three streets with brick, at a total estimated cost of $76,000.

WACO, TEX.—The council is considering a proposition for grading and paving 10 miles of streets, at an estimated cost of about $80,000.

BAKERSFIELD, CAL.—The city has sold $250,000 for 20-year 6% improvement bonds for $251,500. The work will be commenced at once.

ELECTRIC LIGHT AND POWER.

BRIMFIELD, MASS.—There is talk of extending the line of the Palmer & Monson Electric Co. from the station at Blanchardsville to this place.

EAST BRIDGEWATER, MASS.—It is reported that Boston parties have purchased the Sheldon mill property on Vernon St., with the water privileges, and will put in an electric light plant there.

SCHENECTADY, N. Y.—Bids will be received by the council until Jan. 9 for furnishing 1,000-c. p. arc lights for three years from October, 1894, for street lighting.

BALTIMORE, MD.—The Brush Electric Light Co. will make additions and improvements, to cost $300,000, according to reports.

WASHINGTON, D. C.—It is stated that $200,000 will be expended for a new electric light plant for the capitol and new congressional library buildings.

GRIFFIN, GA.—Bonds for $16,000 are proposed for an electric light plant.

JACKSON, MISS.—Bids are asked until Jan. 2 for electric street lighting for five years. L. F. Chiles, Mayor.

CLEVELAND, O.—The only bid for electric street lighting was that of the Cleveland General Electric Co., at $88.60 per light per year for 2,000-c. p. arc lights, each light to burn 2,300 hours, or $100 per light for lights to burn 3,760 hours.

HAMILTON, O.—The council has passed an ordinance providing for an issue of bonds for $50,000 for a municipal electric light plant.

TIFFIN, O.—Bids are asked until Jan. 15 for lighting the streets of the city for five years. Jeremiah Rex, Cy. Clk.

PRAIRIE DU CHIEN, WIS.—A 10-year franchise has been granted to a local electric light company, which proposes to put in a plant at once.

OGDEN, UTAH.—A franchise has been granted to the Pioneer Electric Power Co., recently noted as incorporated, the construction of the plant to be commenced within 18 months.

NEW COMPANIES.—Berkshire Electric Light, Heat & Power Co., Monterey, Mass.; $10,000; Pres., G. O. Etterick, Clayton; Treas., W. E. Hyer, Monterey; G. A. Stevens, New Marlboro.——Thompson Electric Co., Wheeling, W. Va.; $25,000; G. H. Thompson, J. H. Griffith, Martin's Ferry, O.; Alex. Hirth, Wheeling, and others.——Universal Electric Heat & Light Company, Chicago, Ill.; $100,000; J. T. Kretzinger, C. E. V. Akerberg, M. F. Gallagher.——Turney Electric Mfg. Co., Chicago, Ill.; $75,000; Eugene T. Turney, W. H. Crawdus, Wm. E. Mason.——Fuller Incandescent Heat & Light Co., Chicago, Ill.; $1,000,000; J. T. Kretzinger, C. E. V. Akerberg, M. F. Gallagher.

CONTRACT PRICES.

PIPE.—Washington, D. C.—The contract for cast iron water pipe has been awarded to M. J. Drummond, New York. The bids were published in our issue of Nov. 30.

SEWERS.—Fort Howard, Wis.—The contract for a sewer in Willow St. has been awarded to (1) J. K. Delaney, Fort Howard, the other bidders being (2) J. H. Chase Co., Green Bay, Wis., and (3) Anton Brehme, Fort Howard, Wis. The bids were as follows:

	1.	2.	3.
12-in. pipe sewer, per lin. ft	$0 53	$0.55	$0.67
8-in laterals, per lin. ft	0.33	0.35	0.32
Y connections, each	0.95	0.50	0.55
Manholes and catch basins, each	24.00	22.00	25.00

DRAINAGE CANAL.—Chicago, Ill.—The lowest bids for sections G, H, I, K, L and M of the drainage canal were published in our issue of Dec. 7, with a statement of the amount of work required in each section and the names of the bidders. Section M calls for 719,000 cu. yds. of excavation and the other sections from 1,092,000 to 1,330,000 cu. yds. each, all the work being earth excavation. The bids were as follows:

	Sections					
	G.	H.	I.	K.	L.	M.
Bidder.	Price per cu. yd., cts.					
Fred Stafford	..	..	..	31		
Halvorsen, Richards & Co	..	..	..	29.5		
Christie & Lowe	..	..	25	25		
Heidenreich Co	..	..	..	..	19.7	21.7
W. A. McGillis & Co	..	..	..	..	42	
A. J. McBean	..	..	..	..	34.5	34.5
Wm. Innes	..	..	..	..	22	
C. E. Loss	..	..	..	..	35	37.5
McCormick & Moran	..	..	..	49		
Winston Bros	34					
Mason, Hodge & Co	41⅝	37½	35	31	31	35
John J. McCaughey	..	..	..	32.2		
Hayes Brothers	..	31.7	30.4		34.5	35
McMahon & Montgomery	28.4					
Brodhead & Hickey	41	42	40	40	40	40
Wm. Dolese & Co	..	..	..	30		
Streeter & Kenefick	..	35				
Hoover & Mason	..	..	..	..	29¼	
Ryan & McDonald	40	40	37	37	35	35
Casgrain & McDonald	28					
Dawson, Symmes & Co	37	39	38			
Gahan & Byrne	29	29	28	27	2 .9	26.9
Patterson & Shipman	..	..	..	39		
F. H. Clement	..	..	..	..	31	
Ricker, Lee & Co	30					

GRANITE BLOCKS.—Washington, D. C.—The district commissioners have purchased 30,000 second quality granite blocks at $25 and $26 per 1,000 blocks.

PILES.—St. Louis, Mo.—Maj. Chas. J. Allen U. S. Engineer Office, has received the following bids for 30,000 piles for use during 1894: St. Louis Refrigerator & Wooden Gutter Co., St. Louis, 1,221,750 ft. piling, at 6.725 cts. per ft.; Kuse & Loomis Ice & Transporation Co., St. Louis, 6¾ cts.; Sterling Fort, Memphis, Tenn., 5.99 cts. to 7.74 cts.; Chas. Gartner, St. Louis, 6¾ cts. to 7 cts.; John Cleary, Chester, Ill., 225,750 ft., 6¾ cts.; Whitney Gilbreath, Ava, Ill., 389,500 ft., 6¾ cts.

GAS LIGHTING.—New York, N. Y.—The following contracts were made with the gas companies: Consolidated, 13,971 lamps, each lamp to burn 4,000 hours, at $17.50 a year each; Equitable, 3,995 lamps, at $12 a year each; Standard, 2,505 lamps, at $13.04½; Central, 121 lamps, at $24; Northern, 2,200 lamps, at $28; Yonkers, 692 lamps, at $28; New York & New Jersey Globe, 152 naphtha lamps at Woodlawn Heights, at $22.

VAPOR LIGHTING.—Cleveland, O.—The only bid for vapor lighting was that of the Sun Vapor St. Lighting Co., at $18.25 per light per year, which is 83 higher than last year's bid. A provisional bid at the old figure, $15.25, was presented, the provision being that the testing clause be not included in the contract. This year the requirement is for 14 instead of 16-c. p. lights, according to reports.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

GARBAGE CREMATORIES.—Dallas, Tex.—Bids are asked until Jan. 25 for a garbage crematory, 75 cu. yds. capacity, as stated in our advertising columns. G. W. Crutcher, Cy. Secy.

Syracuse, N. Y.—H. F. Stephens, Clk. Bd. of Health, writes us that all bids for crematories and reduction plants were rejected without opening and that the new bids will be received until Jan. 4.

HOOK AND LADDER TRUCK.—Woodland, Mich.—L. C. Feighner, Cy. Clk., writes us that the city intends to purchase a hook and ladder truck, also a hand fire engine.

WATER TOWER.—Cleveland, O.—The fire department has received the following bids for a proposed water tower: Kansas City Fire Dept. Supply Co., $4,000 for a Hale tower; Fire Extinguisher Mfg. Co., Chicago, $4,500.

DAM.—New Haven, Conn.—A local paper states that the manufacturers in the Farmington Valley are planning to build a new reservoir in Nepaug for power purposes. It is proposed to build a dam which will be 12 ft. high, a quarter of a mile long and will cost about $50,000.

LEVEE WORK.—Vicksburg, Miss.—The river commission has been instructed to begin a survey for the levees proposed to be built from the line of the lower Mississippi district southward to Yazoo River. This levee, estimated to cost over $100,000, will be the last link in the chain protecting the Yazoo-Mississippi delta.

SEA WALL.—New York, N. Y.—The Pennsylvania R. R. Co. has been granted permission to build up the sea wall in the gap between Warren and Eleventh Sts. The wall is planned to pass through Desbroses St. ferry, connecting the Laight St. section with that of Canal St., and will make the dock wall about 2½ miles in length.

DRAINAGE DITCH.—New Bedford, Ill.—Bids are asked until Jan. 3 for the construction of four ditches in the Green River special drainage district. The main ditch will be 50 ft. wide on the bottom for 39,900 ft. and 25 ft. wide for 12,370 ft. and will require about 605,778 cu. yds. The work may be let in sections of 1,300 ft. in length. Engr. and Attorney, F. E. Andrews, Sterling, Ill.

DRAINAGE.—Mexico, Mex.—The council of the city of Mexico has awarded a contract for the partial drainage of the city to the promoters of the Orozco scheme, by which the waters of Lake Chalco are to be diverted through the sewers of the city, according to press reports. The contract price is said to be about $100,000, and the work is expected to be commenced this week and to be completed by Feb. 1.

INDUSTRIAL NOTES.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., have sold the double-end express engine "Columbia," exhibited at the World's Columbian Exposition, to the Chicago, Milwaukee & St. Paul R. R.

SNOW PLOWS.—The Ensign Mfg. Co., of Huntington, W. Va., is building Russell bucking snow plows for the Rome, Watertown & Ogdensburg, the New York, Susquehanna & Western and the Western Maryland.

THE BLAKE MPG. CO., of New York, is largely interested in the manufacture of pumping machinery for marine purposes, and its pumps have been adopted by the Navy Department, and are in use on several of the vessels of the new navy.

THE LAIDLAW-DUNN-GORDON CO., of Cincinnati, O., has secured the contract for two water-works pumping engines, vertical compound, for Harriman, Tenn., and one horizontal compound for the Fernandina, Fla., water-works. This makes 16 water-works contracts that have been secured by this company since June 15.

THE HARVEY STEEL CAR CO., of Harvey, Ill., has the contract for remodeling the Illinois Central R. R. special World's Fair cars (Eng. News, Nov. 17, 1892). They are to be standard fruit cars and the changes will consist in the removing of seats, windows and the whole of both sides. Ordinary side sheathing will be put on, and the cars will be fitted with standard doors, intermediate posts and bracing, six ventilators on each side and five on the ends. Ceilings and roof ventilators are also to be put in. There will be the Schoen standard slide doors with covered ventilators on the outside, and Chicago grain doors will also be used, with Coburne trolley door fixtures.

NEW COMPANIES.—Universal Coal Dumping Car Co., Springfield, Ill.; $250,000; James A. Philbrook and T. H. Pearce.——Paving Block Co., Columbus, O.; $100,000; John G. Bolen, A. B. Horne and C. H. Doan.——Granite Filter Co., St. Louis, Mo.; $20,000; A. L. Emery, O. H. Winegar and Edward Morrison.——New Jersey Gas & Construction Co., Jersey City, N. J.; $100,000; C. A. Baldwin, New York, N. Y.; A. L. Fullenwider, Brooklyn, N. Y.——Altamonte Water Co., Duluth, Minn.; $50,000; to develop water power of St. Louis, Cloquet and other uses; E. S. Jenulson, A. C. Martin and others, Chicago; Thos. Kneeland, Minneapolis.